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**OIL-STAIN DAMAGE
IN
TEXTILE PROCESSING**


Based on the work of T. U. Ananthan, G. R. Pillai and J. Zacharia

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INTRODUCTION

The textile industry has had to tackle the problem of oil-stain damage ever since its mechanization. In spite of the advent of sophisticated techniques, increased mechanization, and continuous processing, the incidence of staining from lubricants has not changed appreciably. The situation is aggravated by stringent customer demands for quality and consistency, and developments in processing technology. Stains that were treated as minor defects and overlooked a decade ago are now considered serious and objectionable. Hence an all-out and sustained effort has to be made to reduce staining to an acceptable level.

This monograph is divided into two parts. Part one deals with the sources of staining. Beginning from raw cotton bales, it covers the various states of material and stages of manufacture of processing. Important preventive measures are enumerated for each machine. This part also includes the systems for control of staining and prevalent methods of examination. The importance of materials handling and good housekeeping is stressed. Identification of source from the pattern or nature of stains on the fabric is also discussed.

Corrective measures (i.e., stain removal) that are complementary to preventive measures form part two. The various methods of stain removal, their merits and demerits, the stain removers used and their characteristics are described.

Observations are based on the men, machines, materials and systems used in India. No claim is made to cover all types of machines of different periods of manufacture or to fully cover the practices and procedures followed in other countries. Staining chances may be much less or nil in machinery of more recent design. Nevertheless these observations form a framework on which individual textile mills can formulate a stain-control programme with necessary modifications to suit their requirements.

This monograph was prepared by T.V. Ananthan, G.R. Pillai and Joseph Zacharia of the Bombay Textile Research Association, India.

CONCLUSIONS

The most effective way of tackling oil-stain damage is by preventive measures. This damage takes place mainly in the loomshed, and the major causes are the systems of lubricating, cleaning and materials handling. Improvement can be quick once these systems are studied, modified and standardized. Concurrently, workers have to be trained to work cleanly and to develop quality consciousness. Though slow, this can yield rich dividends.

Next to weaving, ring spinning and winding are the major areas of warp staining. Oily single warps are scattered all over the cloth and hence difficult and laborious to clean.

Preventive measures can only be carried out when the causes or sources of staining are known or identified. This is done by regular inspection of cloth for assessment of stains and determination of sources.

Since staining is a perennial not a transient problem, efforts should be continuous. Routine inspection results should be monitored and fed back to the departments involved for prompt preventive action. The progress or status of control measures should be constantly reviewed. These measures need not be taken in isolation but in conjunction with steps for elimination of other fabric defects and overall improvement in quality.

The best stage for removal of stain is from the grey cloth during inspection and mending. Where sophisticated equipment, techniques and skilled hands are rare, manual spot cleaning is safer and handy. An emulsion-type stain remover is advantageous for this purpose. A centralized oiling system, the use of scourable oil, non-staining grease, handwipes and suitable stain remover are other aids for effective control of the damage arising from oil stains. In addition to financial benefits, this will also enhance prestige and goodwill.

Part one
OIL-STAIN DAMAGE

I. LOSS FROM OIL STAINS

A survey carried out in 11 textile mills in India revealed that the annual loss from oil-stain damage for a composite textile mill is fairly high, ranging from 0.5 to 5 per cent of the total production with an average of 2.6 per cent. The value loss for a 3 per cent stain damage is estimated at 1 per cent. On this basis, an average composite textile mill having an annual turnover of Rs 250 million will incur a loss of Rs 2.5 million a year.

The results of a survey of oil stains on processed superfine fabrics (voile and cambric), covering bleached, dyed and printed material, are shown in table 1.

Table 1. Oil stains on processed superfine fabrics
(Percentage)

Type of stain	Voile	Cambric
Oily warp	26.42	7.22
Oily weft	3.73	3.39
Oil or oily streaks	42.60	32.31
Handling	<u>27.25</u>	<u>1.53</u>
Total	100	100

Stains that were overlooked in the past are not tolerated now, therefore, effective control of staining will result in a substantial saving to the textile industry.

II. SYSTEMS FOR CONTROL

Management's quality consciousness and their recognition of the stain problem is very important. Once the seriousness of stain damage is accepted, it should be assessed. For this purpose, parameters for grouping stains according to their appearance, severity, stage and source of staining can be worked out.

For a fairly good assessment, 5 to 10 per cent of the pieces or rolls, chosen at random, should be examined fold by fold, loose over an inspection table or, for grey cloth, on the loom. The results should be categorized and expressed as stains per 100 m² or 100 m. Snap inspection of looms, overhead structures (if any), handling of warp beams, cloth or cloth rolls, oiling and cleaning operations etc. would further help in detecting the sources of staining and taking effective preventive measures based on the importance and frequency of the stains.

After assessment and initiation of preventive measures and repair, arrangements should be made for effective communication and follow up. An independent unit, such as an industrial engineering or quality control division, can usually be entrusted with this work. Arrangements for detection at every stage help in early prevention. The unit should regularly monitor the stain damage, review progress and feed back information to the management. To augment preventive measures, training programmes for operatives in good housekeeping, materials handling, quality consciousness etc. should be conducted. Instituting rewards or incentives for the best performance would also help in creating an awareness of the problem and in its control.

III. CHECKING FABRIC FOR STAINS

There are three ways of checking fabric for stains. The best one is to pass the cloth through a spotting machine, which is provided with air and steam jets. The cloth moves over a stainless-steel surface where it can be viewed and cleaned. This method is favoured for heavily and extensively stained fabrics.

Inspection machines are a second choice where checking for, and mending, defects are carried out as one operation with stain removal. Some grey goods for export and those for processing are examined by manually pulling the cloth over the table. This method is not perfect as the detection of the stain during the passage of the cloth depends on the co-ordination of pulling and viewing. Also, it is rather tiring and affects the operatives' efficiency.

The third way is to check in plait form grey goods of wider width folded or plaited for grey export, which is done to avoid refolding. The limitations of this method are that the stain removal is restricted to manual spot cleaning and special precautions have to be taken to avoid staining other folds. There is also a likelihood of mildew formation on extensively wetted folds that are not sufficiently dried before packing.

IV. IDENTIFICATION OF STAINS

Contours of oil stains are not sharp. Fresh stains are darker and more pronounced than old ones. In a light fabric of light colour, the oil stain appears transparent when viewed against the light.

Most oil and grease stains show fluorescence under ultraviolet light.

Under a microscope, oil stains appear as a brown mass attached to the fibre or yarn surface. They dissolve in solvents such as carbon tetrachloride.

Oil stains are different from rust stains, which show precise contours, are reddish brown in colour with a rough and opaque surface and no fluorescence. Rust stains are slowly dissolved by oxalic acid, hydrochloric acid or ammonium bifluoride solutions, but oil or grease stains are not.

Rust stains show a characteristic blood-red colour with an acidified potassium sulphocyanide solution and blue with an acidified ferrocyanide solution.

Tar stains are black, stiff and shiny with sharp edges, and dissolve into a black solution on application of a solvent such as kerosene or xylene.

V. LUBRICATING OILS AND GREASES

A wide variety of lubricating oils and greases are used in the textile industry.

Lubricating oils may be straight mineral oils, compounded mineral oils or non-petroleum lubricants, most of them suitably fortified or modified with additives. The grease includes a thickener, which may form a greasy substance such as metallic soap, bentonite, and a fluid such as mineral oil. It also contains additives, complex soaps or modifiers, which serve as anti-oxidants, rust preventives etc.

The lubricant should be stable, i.e., it should undergo minimum change during use. This is very important from the point of view of oil stains. Fresh lubricants cause light stains, which are partly removed by the normal scouring process, but used or deteriorated lubricants cause very dark stains which are difficult to clean by normal scouring (tables 2 and 3).

Deterioration of lubricating oils is evident by the formation of oxygenated compounds, and is accompanied by the development of acidity, deposition of sludge and discoloration. The discoloration is attributable to the presence of resinous and asphaltic substances or nitrogen, oxygen or sulphur compounds and unsaturated hydrocarbons. These oxidized resinous bodies stain or cling tenaciously to fabric. The wear debris, mostly iron particles, forms rust and oil stains making the staining more complex.

The spindle oil used in ring frames should be of good quality, effective and stable, and should be replaced when it shows significant change in acidity, viscosity or ash content and copper strip corrosion. Sludge formation is another indication for oil change.

Non-drip properties of a lubricant minimize dripping and thereby staining of fabric. This is particularly useful for the lubrication of jacquards, dobbies, drop boxes and other overhead parts. Greases with lithium or complex soaps having a high drop-point are not prone to drip at lower temperature and hence are desirable. Lubricants that are scourable are also of help in controlling the staining problem.

Lubricants contaminated with carbonaceous and resinous oxidation products and wear debris stain the cloth. Since oxidation is progressive, the stain

Table 2. Washability tests on lubricants (unused)

Lubricant	Machine or machine part to be lubricated	Appearance	
		On grey cloth	On cloth after bleaching
Spindle oil ^a	Ring frame spindle inset/bolster	Light brown	No stain
Mobil Vactra, heavy	Ring frames roller necks	Very bright yellow	Faint yellow
Telpa oil 40	Doubling machine	Bright yellow	Light yellow
Teresso 35	Schlafhorst winder gearbox oil	Light yellow	Faint
Teresso 52	Schweiter pirn winding machine gear box	Light yellow	Faint
Jello Shell oil	Plain looms	Bright yellow	Light yellow
Milcot 52	Auto and plain looms	Grey	Clearly visible
Alvania grease	Autolooms	Bright yellow	Very light yellow
Multipurpose grease	Autolooms	Very bright yellow	Very light yellow
Kubola 40	Shearing and cropping machine	Light brown	Light red
Teresso 140	Mercerizing machine	Dark yellow	Dark yellow
Teresso 35B	Air compressor drying cylinder	Faint yellow	Not visible
Norva 275	Drying cylinder and calender bearings	Dark yellow	Very faint mark
Becon No. 3	Autolooms	Grey	Very faint marks
Cyndol T.G.140	Sizing gearbox	Brown	Yellow
Surret Fluid 50	Sanforizing machine	Black	Brown
Cyclesso T.K. 140	Mercerizing machine	Brown	Greyish yellow
Gear oil EP 90	All machines in spinning department	Light mark	Very faint mark
Draft lube 2	Ring frames	Very light mark	Very faint mark
Yantrol 43	All machines in spinning department	Faint mark	Faint yellow
Teresso 43	All machines in spinning department	Yellow	Faint yellow
Enklo 140	Mercerizing machine	Light grey	Very faint mark

table 2 (continued)

Lubricant	Machine or machine part to be lubricated	Appearance	
		On grey cloth	On cloth after bleaching
Enklo 65	Yarn singeing machine	Faint mark	Very faint mark
Spintek 35	Spindle insert/bolster	Colourless	No colour
Turbinol 52	Sizing	Yellow	Faint yellow
Gulfspin 33	Spindle insert/bolster	Colourless	No stain
Vitrea 13	Spindle insert/bolster	Colourless	No stain
Servospin 6	Spindle insert/bolster	Colourless	No stain

Table 2. Washability test on lubricants (used)

Lubricant	Machine or machine part to be lubricated	Appearance	
		On grey cloth	On cloth after bleaching
Vitrea 13	Ring frame spindle insert/bolster	Light brown	Pale brown
Gulfspin 3	Ring frame spindle insert/bolster	Reddish brown	Brown
Spintek 35	Ring frame spindle insert/bolster	No visible colour	Colourless
Servospin 6	Ring frame spindle insert/bolster	Light reddish brown	Pale reddish brown
Mobil Vactra, heavy	Ring frame roller necks	Bright yellow	Yellow
Telpa oil 40	Doubling machine	Light brown	Brown
Teresso 52	Barber Colman spooler (cheese core bearings)	Black	Dark brown, prominent
Pen-o-led oil	Barber Colman spooler gearbox (main)	Dark yellow	Bright yellow
Teresso 35	Schlafhorst winder gearbox oil	Yellow	Light yellow
Teresso 65	Zell-Ate-Sizing machine beam creel	Black	Grey
Jello Shell oil	Plain looms, crankshaft, bearing, picking bowl, and take-up wheels	Jet black	Black
Mil cot 52	Plain and auto looms	Brownish black	Yellow
Alvania grease	Picking tappet	Black	Very pale brown
Multipurpose grease	Auto looms	Jet black	Dark brown
Kubola 40	Shearing and cropping	Black	Brown

gets further oxidized when allowed to remain on the cloth for a long time before removal. Heat and metal contaminants accelerate this process. It is therefore advantageous to clean the fabric at the grey stage rather than allow the stain to get further oxidized and attached to the cloth during wet processing.

VI. CAUSES OF STAINING AND PREVENTIVE MEASURES

The problem of staining can be reduced by investigation and identification of its sources and by preventive measures. An elaborate survey was conducted at various textile mills from cotton bales to finished fabric to trace the probable source of oil stains; several case studies were also undertaken. The findings are given below.

Raw cotton bales

Raw cotton bales contained hessian bits from packing, coloured rags, oily black stains from ginning machines and tar particles. The tar particles, which adhere tenaciously to cotton fibres, came from the tar-lined paper or hessian bags used by the cotton pickers, tar-marking on bales, tar coating on the metal bands of cotton bales and tar-coated roofing of ginneries and warehouses. Occasionally, cotton stained with black blotches of lubricant was also noticed (Figure 1).



Figure 1. Cotton stained at ginner.

Causes. Some of the stained fibres escape routine cleaning and combing and cause fibre or yarn staining, black foreign matter to be spun into the yarn and black spots on finished cloth. The minute tar particles remain insignificant on yarn but melt and form prominent pin-heads during drying or calendering operations.

Prevention. The use of cleaner cotton, which could be implemented by precautionary measures in cotton picking, ginning, baling and marking. Some of the large oily blotches should be detected and removed at the feeding lattice and mixing bin.

If possible, the ginnery or supply station of the stained cotton batch should be traced in order that suitable preventive measures can be taken.

Soft waste mixing

Likely causes. Soft waste usually contains black oily portions from sweepings.

Prevention. Regular and careful checking of soft waste mixing and removal of oily waste.

Blow room

Likely causes. Occasional dripping or seeping of oil from the overhead lineshaft bearings, from the plain bearings of opening machines and from the oil-lubricated scutcher bearings.

Prevention. Careful oiling and periodic cleaning of oily machine parts.

Transportation of cotton laps

Likely causes. Staining of lap layer from oily floor due to careless materials handling.

Prevention. Avoid storing cotton laps on oily or dirty floor.

Carding

Likely causes. Staining of cotton fibres from the bearings of the licker-in, oil-lubricated doffer comb box, oily or soiled calender rollers at the cards and dropping of oil from line shaft.

Prevention. Careful oiling of respective machine parts and frequent cleaning of overhead line-shaft bearings and soiled calender rollers will minimize the staining.

Drawing frame

Likely causes. Starting production on drawing frame immediately after lubrication.

Prevention. After lubrication of the machine, the drafting rollers etc. should be wiped free of oily matter.

Comber

Likely causes in certain old models. Staining of cotton fibres from the oil-lubricated cradle mechanism. Oil leakage from the frame-end causes the floor to become oily, which in turn stains cotton bits or cotton sliver falling onto the floor.

Prevention. Avoid over-lubrication of cradle mechanism and ensure that any excess oil over the machine parts is wiped off. A tray may be provided to collect the oil leakage to avoid it spreading onto the floor.

Speed or fly frame (old models)

Causes:

- (a) Use of oil-stained empty tubes;
- (b) Over-lubrication of flyer spindles;
- (c) Over-lubrication of drawing roller bearings causing staining of sliver roving when passing over the roller;
- (d) Oil dripping from overhead transmission bearings onto creels and bobbins;
- (e) Piecing broken ends with dirty or oily hands;
- (f) Transporting roving in dirty boxes, over-filling boxes causing spilling onto a dirty floor and storing rovings on a bare dirty floor (figure 2).



Figure 2. Rovings stacked without cover on dirty floor

Prevention:

- (a) Stained tubes should be cleaned before reuse or not used at all;
- (b) Excessive oiling of flyer spindles should be avoided;
- (c) Lubrication of drawing roller bearings should be minimal;
- (d) Overhead transmission bearings should be cleaned frequently;
- (e) Oily hands should be cleaned before broken ends are pieced;
- (f) Bobbins should be transported and stored in clean boxes without spillage.

Ring frame

Causes:

- (a) Splashing of oil from spindle insert/bolster after oil filling and topping;

(b) Excessive lubrication of roller necks or roller stand open bearings, which allows the adjacent apron or roller to become oily and collects fluff that becomes oily by capillary action;

(c) In the case of repeated yarn breaks in any particular spindle either due to a damaged ring wall or excessive traveller friction, the ring frame tenters are in the habit of applying a little oil or grease to the ring thereby causing yarn staining;

(d) Piecing broken threads with oily hands;

(e) Using stained bobbins for piecing at the start of the new doff;

(f) In certain old models of ring frames, the draft rollers adjacent to the gearbox are usually oily due to the seepage of oil from the gear box. These oily draft rollers stain the sliver passing over them;

(g) A thin layer of oily dirt particles below the traveller's path of the inside lower edge of the ring causes bobbin stain. This occurs when the knee brake is applied or while doffing. The bobbin tilts out slightly, rubs against the inner oily wall and gets stained (figure 3).



Figure 13. Bobbin stained from dirty ring

Prevention

(a) When filling and topping oil in the spindle insert, only reasonable quantities should be applied to prevent the oil from splashing into spindle wharves and tubes. It is advisable to run the spindles without tubes for a short time after filling or topping;

(b) Oiling of roller necks or draft roller stand of ring frames should be done carefully to avoid soiling of roller or apron surfaces to prevent oil stained yarn;

(c) Ring should not be lubricated;

(d) Oily hands should be cleaned before piecing broken ends;

(e) Stained bobbins should not be used;

(f) A tight washer should be inserted on the draft rollers near the gearbox to prevent oil seeping from the gearbox;

(g) Oily dirt particles below the traveller path of the inside lower edge of the ring should be cleaned periodically.

Doubling frame

Causes. Excess oiling or greasing of plain bearings or roller necks, staining of yarn falling into oily roller axle owing to:

(a) Top weighting rollers kept in the wrong direction;

(b) Top weighting rollers having no grooves or shallow grooves;

(c) Yarn having a tendency to loop out and fall onto the axle when the frame is stopped and not put back on restarting (figure 4).

Prevention:

(a) Over-oiling of bearings and roller necks should be avoided;

(b) The top weighting rollers should be checked and kept in the right direction;

(c) There should be proper grooves on the top weighting rollers;

(d) The yarn from the axle should be put back over the roller portion within the groove before restarting the frame.

Multi-groove rings

Causes. On doubling frames where the rings are of the multi-groove type or manually oiled, oily rings are formed on the bobbins. Generally, three consecutive bobbins are found stained at the same height. This is caused by

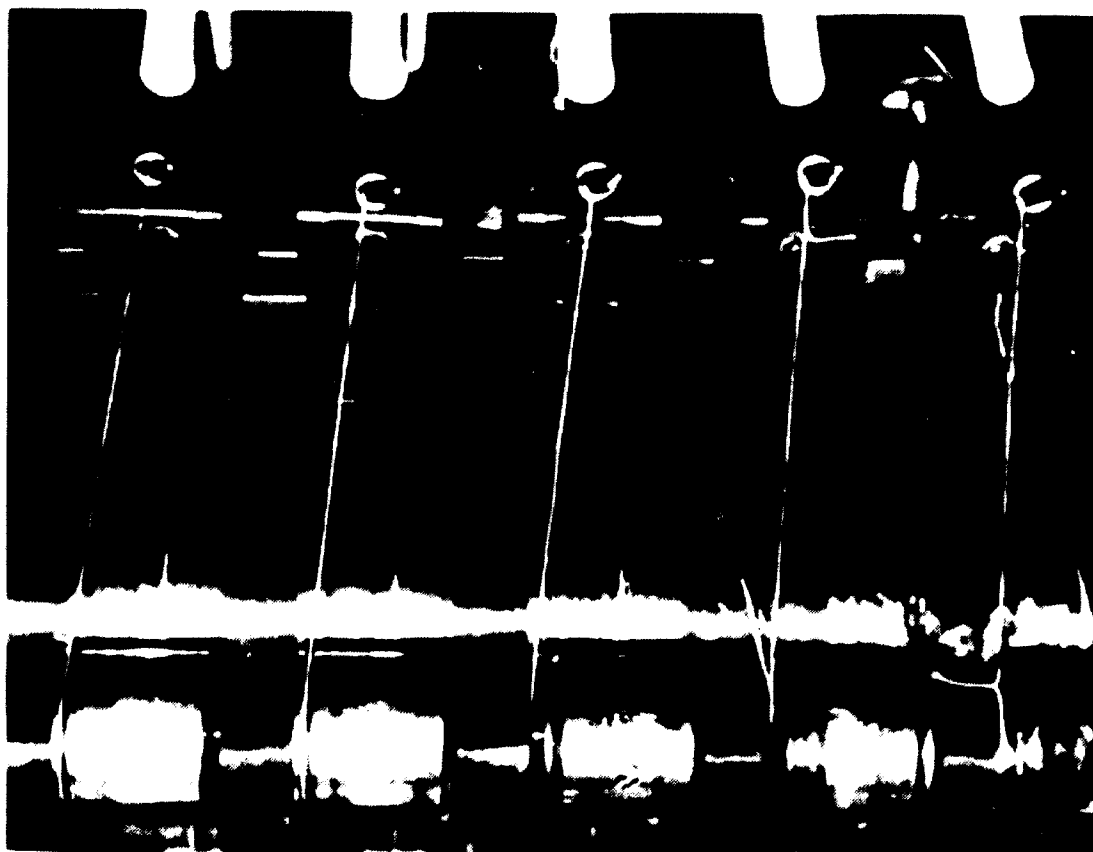


Figure 4. Yarn touching dirty axle at the frame
stoppage

the yarn in the middle bobbin breaking and the broken end or tail lashing against the oily ring, getting stained and not only staining the same bobbin but also lashing against the adjacent ones and staining them at the same level (figures 5, 6 and 7).

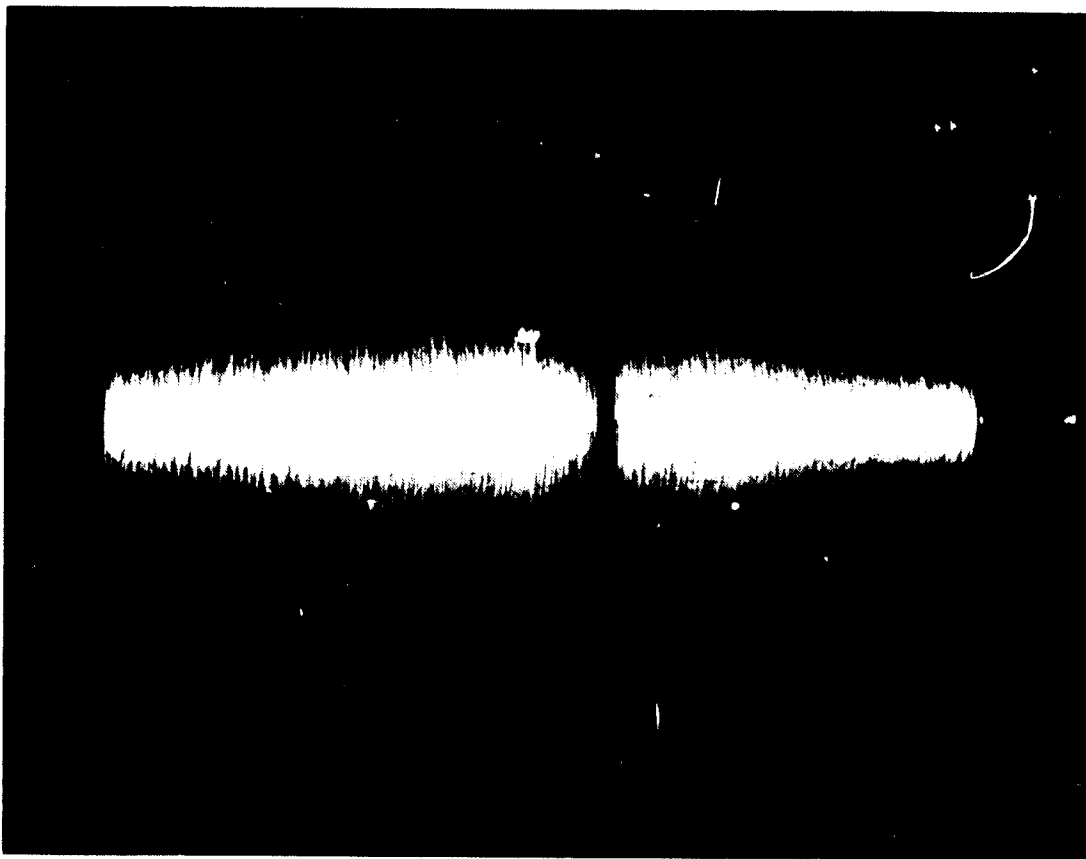


Figure 5. Bobbin stained from oily multigroove ring

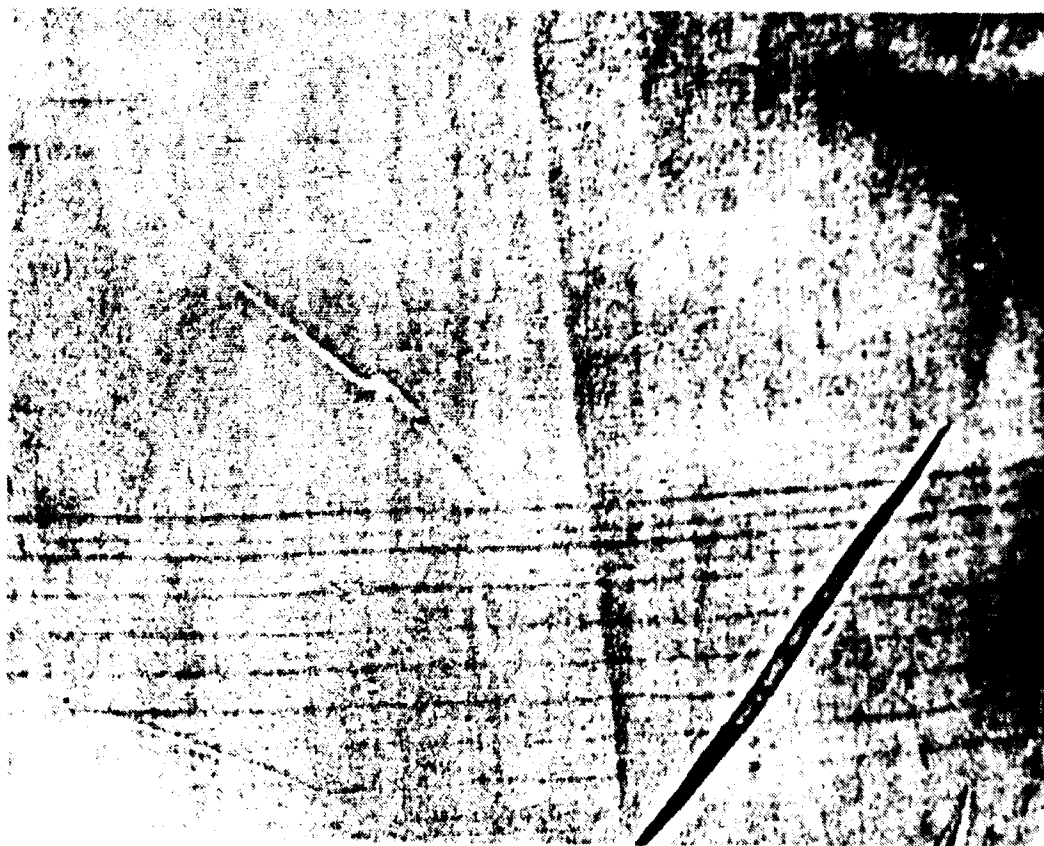


Figure 6. Cloth from bobbin stained from multigroove ring



Figure 7. Oily weft marks from bobbin stained from dirty ring

Prevention. Washable lubricant should be used so that the stain will wash away in wet processing. Suitable bobbin separators should be used to minimize staining the adjacent ones.

Atmospheric carbon on bobbins

Causes. Working of synthetic blended yarn in doubling frame for long hours, especially in winter (when the air is more polluted), attracts atmospheric carbon which is deposited over the bottom portion of the full bobbin. This yarn when woven as weft, shows a faint weft band.

Prevention. An air filter in the doubling frame section should be used and the bobbin started at a little higher level than usual. The bobbin should be doffed early, especially in winter, to avoid long exposures to carbon deposits.

Hank reeling machine

Causes. While doffing the reeled hank through the hank wheel, the hank touches on the oily surface of the wheel and bearings and gets stained.

Prevention. The outer surface and bearings of the hank wheel should be kept free from oil or grease, and a washable lubricant used.

Ring frame tenters and doffer gaiters

Causes. Full ring bobbins are often found underneath the ring frame lying stained on the oily or dirty floor. This is due to the carelessness of the doffer gaiters during doffing and transportation (figure 8).

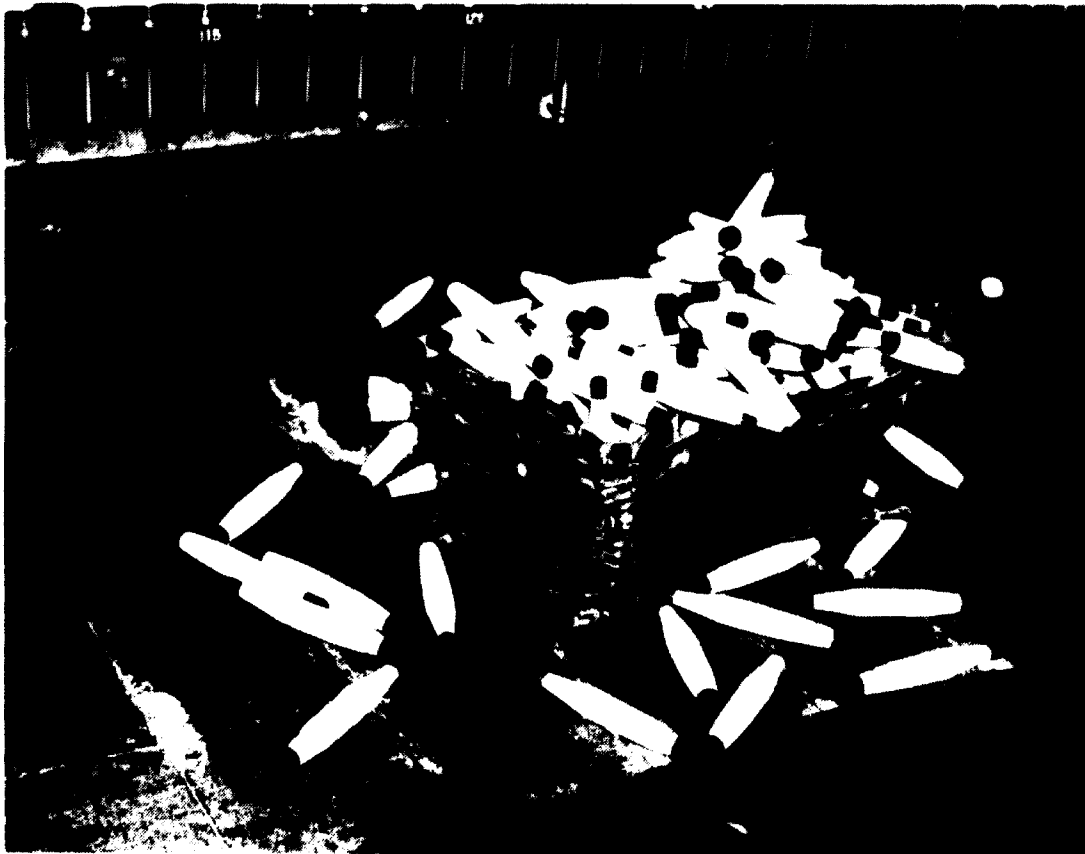


Figure 8. Spilling of ring bobbins from overfilled doff box

Transportation of yarn bobbins in soiled bags and dragging torn or loosely woven bags over an oily floor cause damage to, and stain, the yarn (figure 9).



Figure 9. Bobbins spilled from torn gunny bag

The doff carriers are in the habit of dragging the doff boxes over the oily or dirty floor and after filling them with bobbins stacking them one on top of another. The oily base of the doff box stains the bobbins below.

Workers piece broken ends without wiping or cleaning their oily hands. Some operatives apply oil onto rings with cotton waste, staining the bobbin in the process. This will produce oily yarn of warp or weft.

Prevention. Doffing and transportation should be carried out with care and the over-filling of doff boxes discouraged. The piecing or handling of bobbins should be done with clean hands; workers should be instructed to use a handwipe or cleaner. The practice of oiling the rings with oily cotton waste should be discontinued.

Weaving preparatory

Double winder

Likely causes. In some old models, yarn cheeses adjacent to the main shaft bearings were often found to be stained. This was due to grease oozing from the shaft bearings and settling on the shaft surface along with the fluff. The traverse guide, during its movements, picks up this grease and oily fluff and stains the yarn passing through it. This happens especially immediately after greasing, whenever the bearing gets too hot or when grease with a low melting point is used. Excess oiling or greasing of the cheese holder, as well as the accumulation of oily fluff, stains the cheese on the edges. During weekly cleaning, the dirt and oily fluff from machine parts are blown over the bobbin bins, staining the bobbins inside.

Prevention. High drop-point grease should be used. Excess oiling or greasing should be avoided and the shafts wiped frequently to keep them clean. The cheese holders should be cleaned periodically to free them from dirt etc. The bobbin bins should be covered while cleaning.

Blower of spooler traveller

Likely causes. Oil leaking from the blower of the spooler traveller due to overfilling or leakage in packing drips onto the ring bobbins in the box at every round of the traveller. Machine parts removed from the spooler during maintenance are kept in the doff box of working ring bobbins, causing dirty oil spots on the ring bobbins.

Prevention. Suitable sealing arrangements should be provided to prevent the seeping of oil, and a washable lubricant used. Spare machine parts should be kept in their own box.

Pirn winding machines

(a) Universal (old model)

Causes. Any oil leakage from the gearbox stains the pirns through the following parts: spurting oil from the cover, cop holder, starting lever, traverse bar, support bracket and stopping lever rod.

Prevention. Suitable sealing arrangements should be provided to prevent the seeping of oil, and a washable lubricant used.

(b) Universal cup pirn winder

Causes. The pirn is likely to get stained from the oil cup and dropping of oil from the spindle holders.

Prevention. Suitable sealing or packing arrangements should be provided to avoid this staining.

(c) Automatic

Causes. The incidence of oil stain on pirns occurring in pirn winding is negligible. However, some points were noted such as accumulation of dirt and oily fluff on the rotary thread cutter, static conveyor belt and pirn chutes, and oil leakage from the winding head (gearbox) causing pirn stains. Sometimes fitters, while repairing the machine, cause a few pirns to become dirty or oily. Dirty or oily pirn holders stain pirn heads. The stained pirn heads stain other pirns when they fall over in the pirn container or during handling. Fluff settles on the leakage from winding gearbox seals and is blown over pirn boxes staining the pirns.

Prevention. The pirn chute on which the wound pirns rest before they fall into the collector should be cleaned frequently. The washer inside the pirn driving head, static conveyor belt, pirn tip holder, rotary thread cutter etc. should be kept clean.

Sizing

Causes. The stains from size lumps are washable, but sometimes oily fluff from the size box roller gears get stuck upon the cylinders and the rollers causing comet-shaped oily fluff marks on the warp sheet at regular intervals. This is due to the negligence of the sizers.

Lubricant dripping into the size box is due to excess lubrication of squeeze roller and guide roller bushes or bearings and causes warp stains.

Careless handling of sized beams during storage and transport by allowing the oily edge (ruffle) of one beam to bump against the yarn body of another beam causes warp-group stains (figure 10).

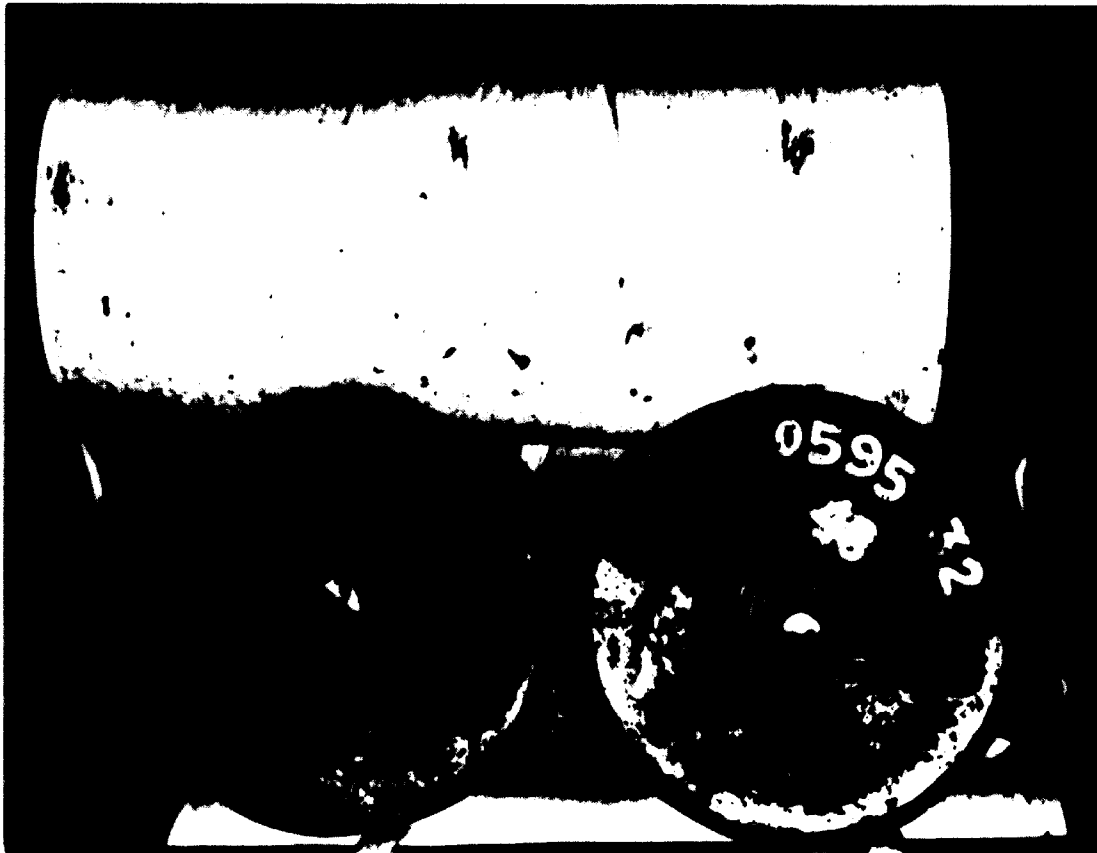


Figure 10. Beams stored incorrectly

Prevention. Sizers and back sizers should promptly remove all oily fluff and hanging grease from the bearings. Excess lubrication on roller bearings should be avoided. Grease of a high drop-point should be used. Sized beams should be wrapped and handled carefully during transport and storage.

Weaving

The weaving section contributed the lion's share of oil stains on fabric, ranging from 55 to 75 per cent. This is due to such factors as chronic congestion, inadequate cleaning, improper oiling, indifferent operatives and poor materials handling. A co-ordinated effort for improvement of all these aspects would keep the stain menace well under control.

Non-automatic overpick looms

Causes. Over lubrication and subsequent splashing of oil from crankshaft bearing, picking side shaft bushes and picking tappets stains the warp sheet and cloth (figure 11).

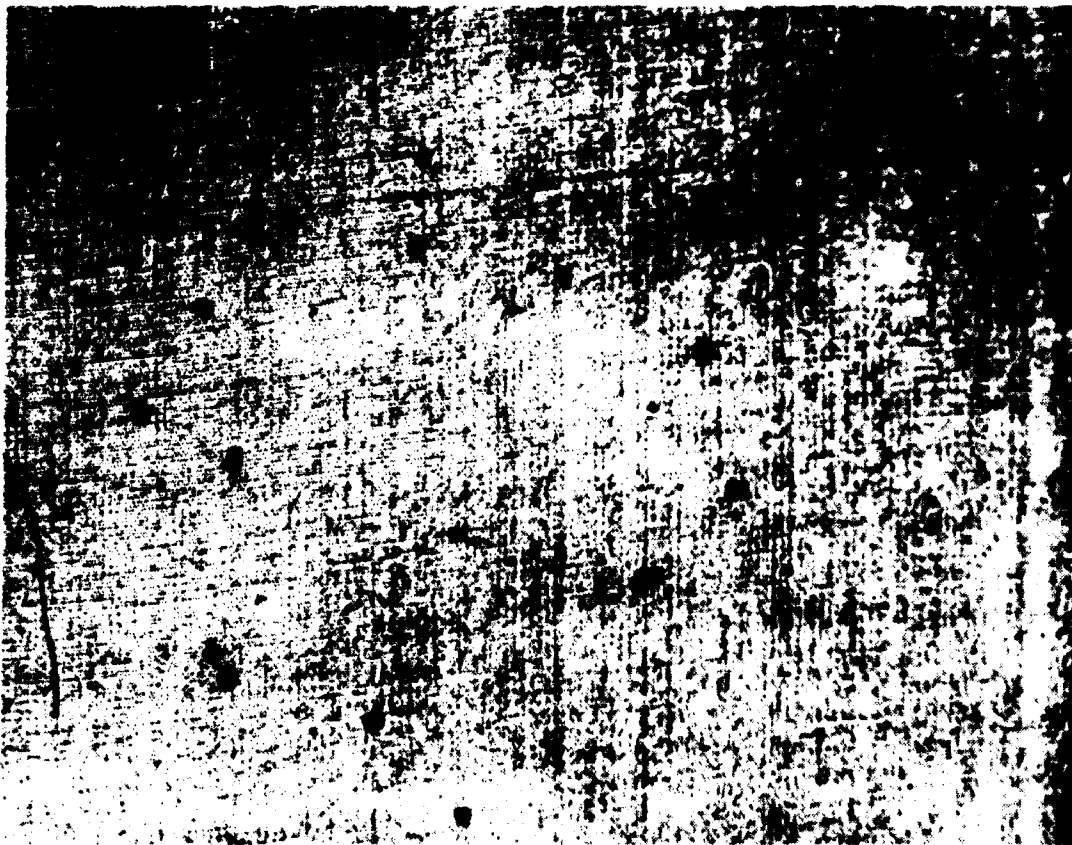


Figure 11. Oily splashes on cloth

Dripping or dropping of oily dirty matter from the top roller bushes onto the shed causes warp stains and oily foreign matter is woven in.

Excess oiling of shuttle box spindle splashes the oil onto the buffer making the box oily and dirty. This stains the weft yarn.

The hide pickers need periodic lubrication of shuttle box spindles.

The picker on its repeated strokes transfers this oil mixed with fluff to the buffers. The accumulated oily fluff is picked up by the shuttle, deposited in the shed and woven in. This type of stain is worse when nylon buffers are used in conjunction with hide pickers.

Excess oil applied to the chain let-off connected to the beam spreads towards the selvedge yarn on the warp beam and causes long continuous selvedge staining.

Prevention:

- (a) Excess oiling of machine parts should be avoided;
- (b) A cloth curtain to screen the warp beam from oil splashes should be provided inside;
- (c) The top roller bush should be well covered or non-lubrication bushes, for instance made of nylon, should be used;
- (d) The shuttle boxes should be cleaned periodically and the spindles wiped;
- (e) Nylon picker and buffer should be used, which avoids lubrication, or scourable lubricant used on the box spindle;
- (f) The chain let-off should be carefully oiled.

Reed

Bitumen particles fall from the pitch-bound reed into the warp shed, become attached to the warp and when woven in cause black spots on finished cloth.

Prevention. All-metal reeds should be used or the bitumen coating of the reed should be maintained in good condition.

Automatic looms

Causes:

- (a) Falling of oily fluff or dirty matter over the warp sheet from the top roller bushes;

(b) Splashes of oil or dirty matter onto the warp sheet and beam from the underloom parts;

(c) Splashes of oil on cloth roll from the twill tappets when the cloth roll grows in size and comes nearer the tappet;

(d) If the bottom surface of the pressing hammer of the weft replenishing mechanism is oily or dirty, it may stain the pirn at the transfer. Oil drips from battery mechanisms, such as the pushing pawl, bunter and bunter lever, over the pirns and onto the empties in the box below;

(e) Excess oil applied in certain warp stop gearing might splash oil over the warp sheet;

(f) If excess grease is applied onto the cloth guide roll bracket, it spreads by the help of accumulated fluff onto the emery roller and stains the fabric when passing over it. This staining is noticed when the cloth is woven at maximum width in the loom (figure 12);



Figure 12. Cloth stained from dirty emery roller

(g) Where the weft feelers are of a serrated type, the finger swell might contain oily dirt particles that stain the weft pirn on the shuttle passage;

(h) In Ruti looms, extra chain lengths hanging on the spring top motion tappet collect grease and oily fluff which, owing to vibration, drops on the warp sheet and cloth. Occasionally grease is found mixed with oil on the top motion tappet chain, causing the splashing of oil over the warp sheet during the running of the loom. Oily matter is also dropped onto the warp sheet when the top motion spring breaks;

(i) Unwanted grease applied over the finger swell and knock-off lever makes the weaver's hands oily or greasy;

(j) Over-oiling or choking of picking bowl stud often leads to the splashing of oil onto the warp beam. When a narrow width cloth is woven on a wider width loom, there is a possibility of this oil splashing onto the adjacent warp beam in the absence of a warp beam curtain;

(k) The oiling point on the temple bar stud fixed at the back of the front rest of certain automatic looms lies a little below the woven sheet of cloth. Accumulation of fluff at this point is likely to cause the oily fluff to stain the cloth and leave a continuous line of oil stains on the lower side, which, incidentally, is the face side in such fabrics as drills and satins. Being on the wrong side, it is not visible on the fabric during weaving. This type of staining is rare and occurs only when a new beam is started.

Prevention:

(a) Excess oiling or greasing should be avoided and, if possible, the bush properly covered to prevent any falling of dirty matter. The use of bushes needing no lubrication is also favoured;

(b) A cloth or polythene curtain should be provided to screen the warp beam;

(c) A separator may be provided between the cloth roll and twill tappets or high consistency grease may be used over the tappets;

(d) The battery mechanism should be carefully oiled and the parts cleaned frequently;

(e) Careful lubrication and wiping of oily parts is helpful;

(f) Before beam gaiting, the guide roll and emery roller should be cleaned of fluff, yarn bits etc.;

(g) Excess oiling of the feeler box should be avoided; and the feeler tip cleaned frequently;

(h) Extra links should be tied to ensure that they do not swing. Care should be taken in lubricating top motion spring tappet. A rod fixed near the spring tappet motion will hold the tappet if the spring breaks;

(i) Excess lubrication should be avoided; accumulated fluff should be removed, and dirt from the finger swell and the warp tension spring device should be cleaned;

- (j) The picking bowl stud should not be excessively lubricated;
- (k) The temple bar stud should be kept clean;
- (l) A tray or sheet should be placed below the loom to prevent the alley space getting dirty;
- (m) A plastic foldable cover should be kept on top of the battery to avoid the depositing of foreign matter onto pirns;
- (n) The pirn box should be kept on a suitable bracket at the top rail above the battery instead of being placed on the ground or tied in between two looms (figure 13). The falling of weft bobbins onto the dirty floor during distribution should be avoided.



Figure 13. Pirn box placed incorrectly

Staining from overhead structures

Pineshafts

Causes. Excess oil in the overhead lineshaft travels along the shaft, and when at rest drips down through any sticking lint. Under the bearings of these shafts are hung trays which sometimes overflow or tilt spilling the oil. Oil drips directly from the bearings when there are no trays or damaged trays are not replaced promptly.

Prevention. Lineshafts should be cleaned frequently and riders or rings used on them to prevent accumulation of fluff. A tray is essential under a lineshaft bearing and it should be cleaned periodically and kept properly. A tight washer on the lineshaft over the tray on either side of the bearing will prevent the oil from travelling along the shaft.

Dobbies

Causes. Due to vibration, dirt or oily fluff drops from the dobbies (figure 14) onto the warp sheet and the cloth in the absence of a tray or cover underneath (unconventional type open-dobbies) resulting in the formation of warp stains (figure 15), streaks and foreign matters being woven in.

After oiling or greasing, the dobbie driving chains on autolooms, by their vigorous vibrations, allow the lubricant or dirt to fall over the shuttle and pirn. Though rare, this may cause oily black weft on cloth. Also, the fly wheel gets stained, which may in turn stain the weaver's hand.

Prevention. Regular cleaning of the dobbie structure and a suitable tray or cover should be provided at the bottom to avoid the dripping of oily matter over the cloth or warp sheet. The driving chains may be covered up, loose chains should be tightened, loose fluff removed and excessive lubricant avoided.

Jacquard

Causes. Jacquard driving main chains are often greased and after greasing, due to vibration, they splash out thick black specks over the battery pirns and the warp sheet and cloth causing oily warp groups and cloth stains.

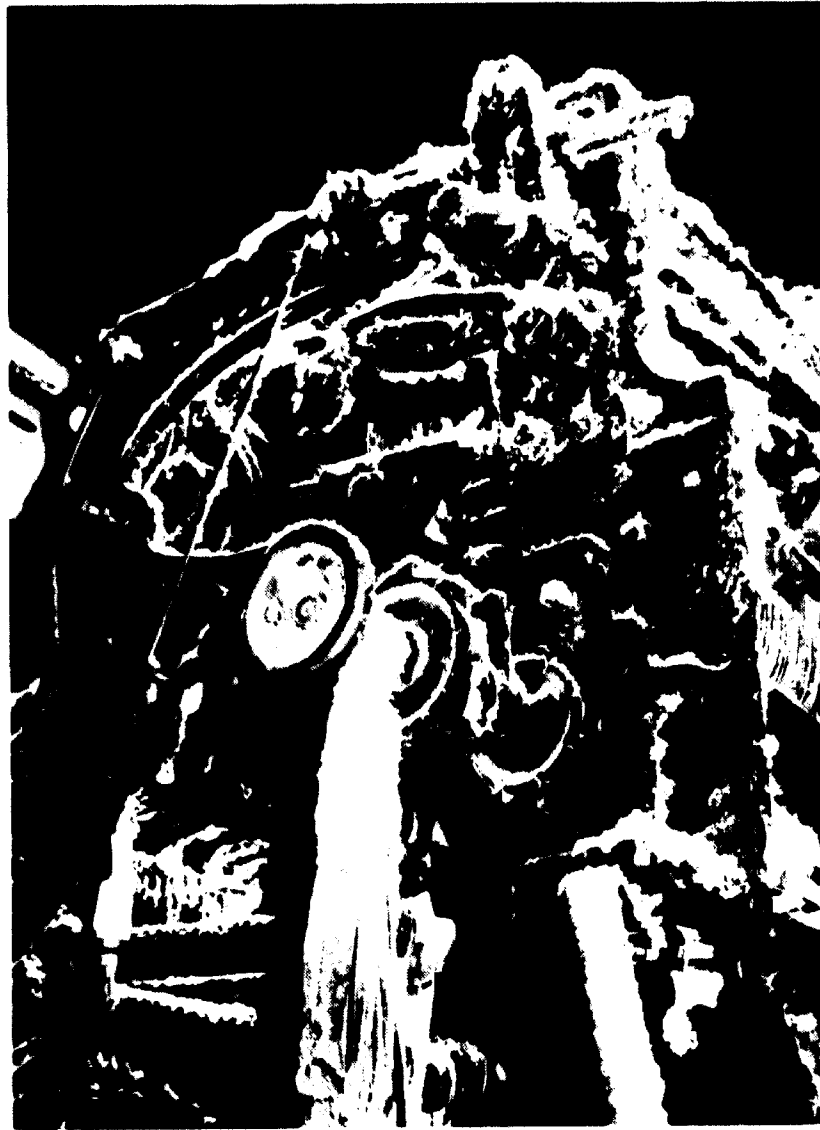


Figure 14. Dirty dobbies

Prevention. Jacquard main chains should be shielded to prevent any splashing of oil or dirt. High consistency grease should be used for lubrication.

Drop-box looms

Causes. Drop-box heald chains are often oiled. These chains have additional loose links and when they contain excessive oil and dirty matter,

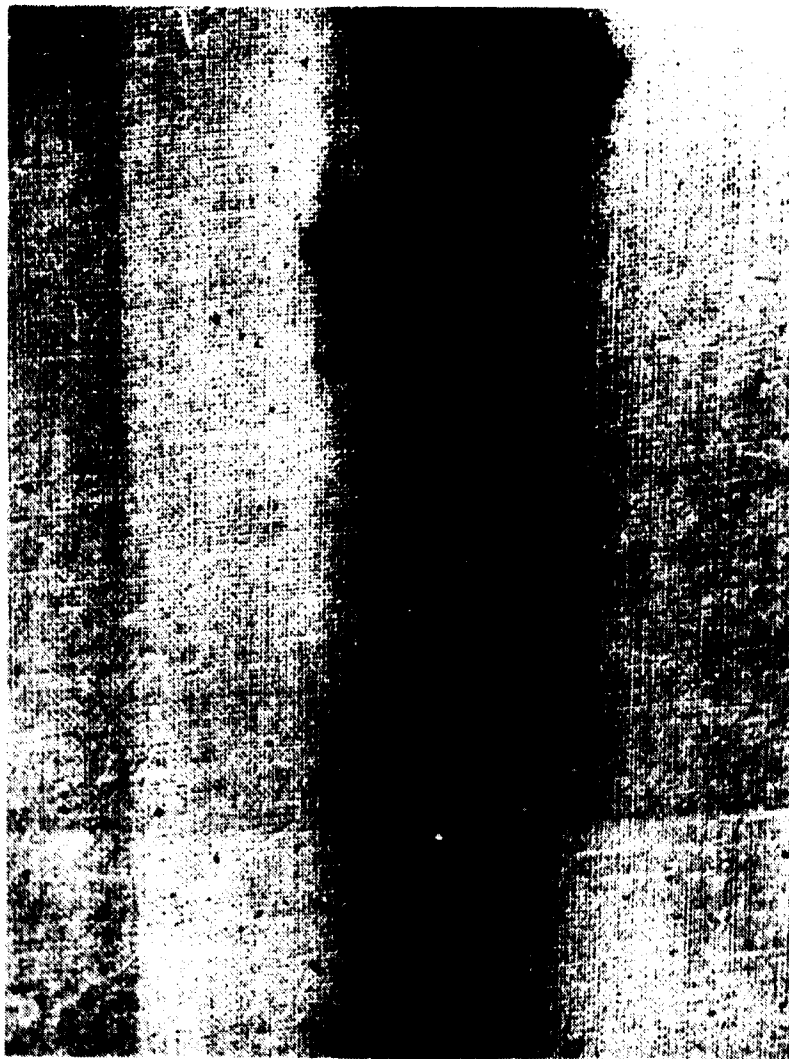


Figure 15. Oily warp streak

black oil specks splash down over the cloth on the loom and warp sheet. This causes continuous staining near the selvedge

Prevention. These splashes can be prevented by having partial covers over the chains. The extra chain lengths should be left where the healds link, not where the levers link.

Practices of operatives

Operatives lacking skill and training are responsible for the occurrence of certain oil or handling stains. The more common ones are listed below:

Oiler

Causes:

(a) Certain oilers never bother about oil drip from their oil-can tip while lubricating overhead mechanism, such as dobby and jacquard, which causes staining of cloth and warp group;

(b) The practice of standing on bare oily feet over the cloth on the front rest of the loom to lubricate overhead structures is still prevalent in some mills;

(c) Careless oiling of battery parts results in the oil dripping onto the shuttle causing oily weft and shuttle marks on the fabric. It also stains the pirns producing oily weft;

(d) Some oilers are in the habit of separating the warp sheet with oily hands to lubricate the underloom parts, which causes warp stains;

(e) Similarly, while greasing or oiling underloom parts, such as shedding tappets, treadle lever, gears, the oiler's brush, grease gun or oil-can tip touches the warp sheet and the cloth roll causing stains;

(f) Oilers are in the habit of mixing a little oil with the grease to make it less viscous for brush application. This, however, causes the liquid mix to splash or drip onto the cloth.

Prevention. The oilers should be instructed and trained to do the job correctly and carefully. The use of a long-spouted oil-can instead of a brush for greasing is recommended. A centralized lubrication system for each machine is preferable, wherever possible.

Loom cleaner

Causes. Careless cleaning and blowing of the top motion tappet drive, top roller bush, plain dobby, and jacquard allow oily dirty fluff to fall onto the warp sheet and cloth and cause repeat stains on the cloth roll. Another careless practice is cleaning a loom with an air jet while working, and blowing the oily fluff out over the working adjacent looms, which results in the oily fluff being woven in.

Prevention. Before cleaning the oily overhead parts, the warp sheet and cloth should be adequately covered so that falling matter can be collected and removed. It is advisable to use separating screens while cleaning a loom with an air jet to prevent the dirt being blown onto adjacent working looms. After cleaning operations or holidays, any oily fluff or dirt collected over the warp sheet and cloth should be fanned out before restarting the looms. As far as possible, cleaning operations should precede, not follow, oiling.

Battery filler

Causes. Careless filling of the pirms on the battery causes one or more to drop on the oily floor, staining them (figure 16).



Figure 16. Stained pirms in battery

Prevention. Instead of putting the stained ones back on the battery, they should be segregated or removed. Further, any stained pirns found on the weft box or trolley should be segregated while loading the battery. The segregated oily pirns can be utilized when starting a new beam.

Weaver

Causes:

- (a) Inadequate cleaning of the shuttle boxes causes the accumulation of dirt or foreign matter, which causes the formation of woven foreign matter, box marks and weft streaks;
- (b) Careless piecing of warp breaks with greasy or oily hands causes stains;
- (c) The habit of applying a little grease or oil to the shuttle eye to prevent friction and reduce weft breakages, and to the rusty reed to smooth the surface, produce stains;
- (d) Over-lubrication of the box spindle on plain over-pick looms produces staining;
- (e) Doffing the cloth roll over the dirty floor and working the loom after doffing but before replacing the empty roll allow the cloth being woven to drop over the dirty oily floor (figure 17);

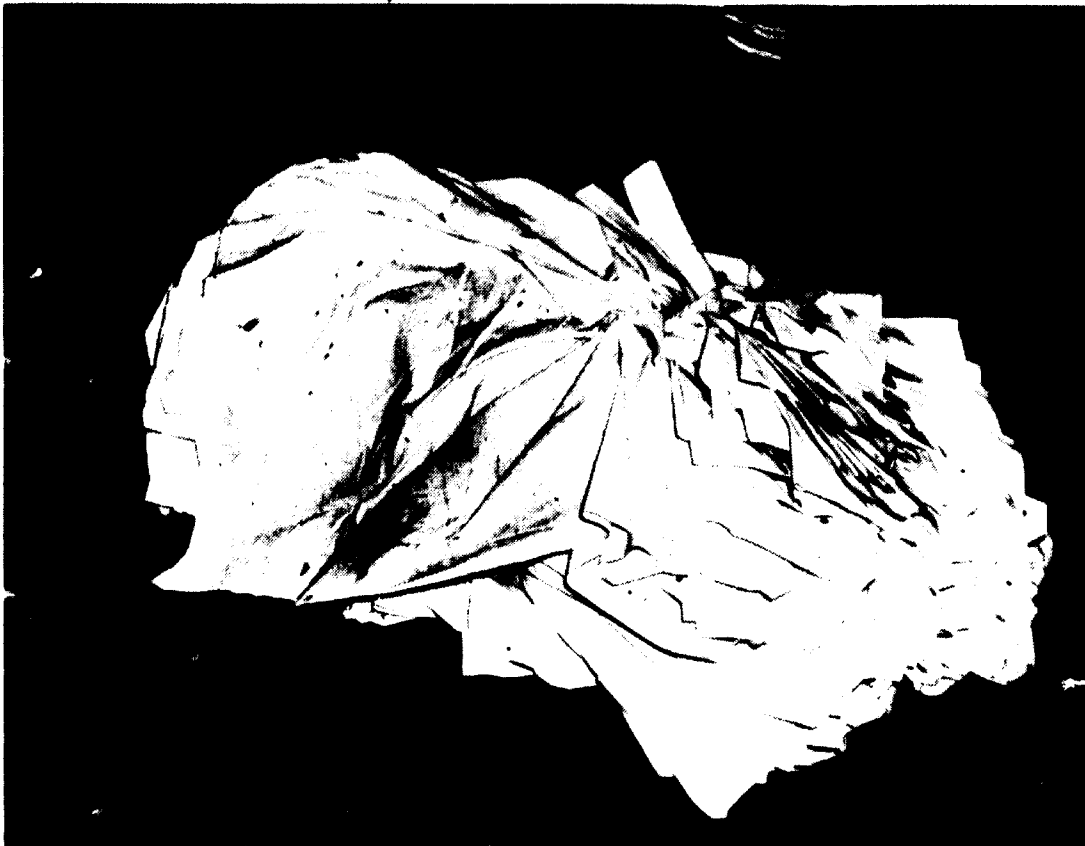


Figure 17. Cloth doffed over dirty floor

(f) After a holiday or long stop for major repairs or cleaning the overhead structures, the weaver restarts the loom before fanning off the dirt or fluff particles from the cloth and warp sheet, which causes dirty matter to be woven in (figures 18 and 19);

(g) Feeling the warp tension with oily hands after adjustment or repairs causes stains (figure 20).

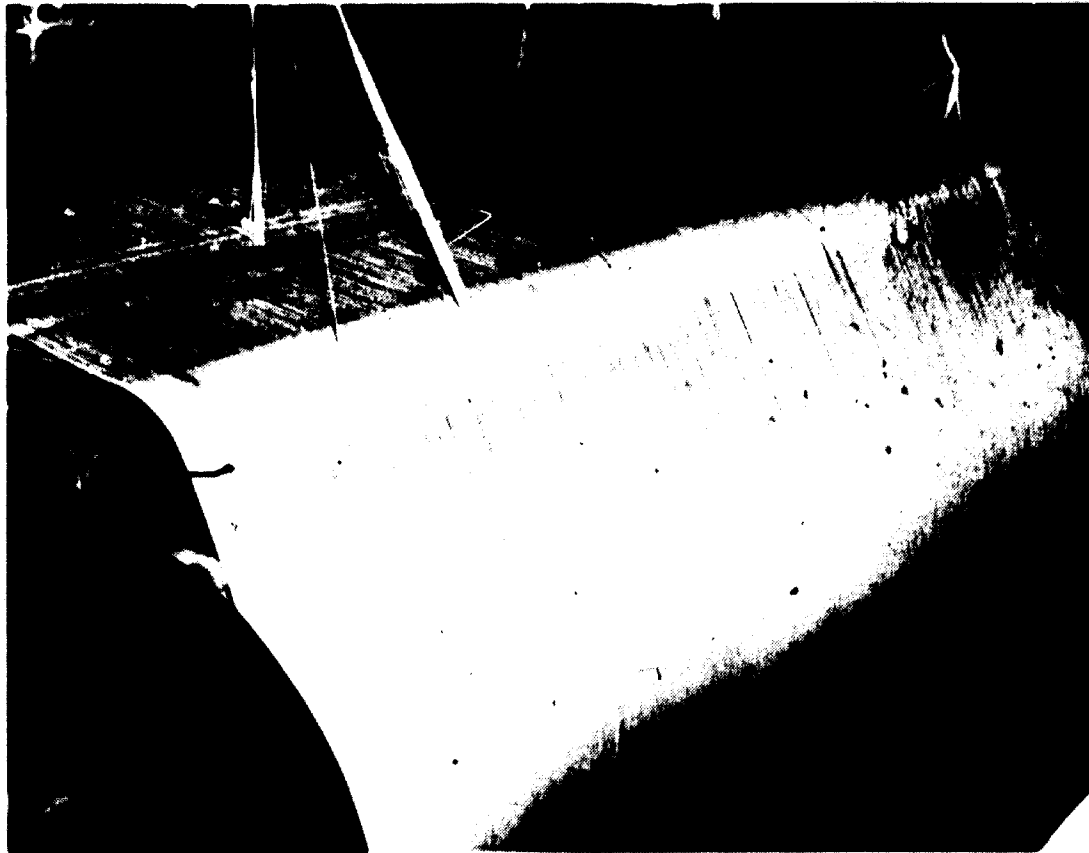


Figure 18. Dirty fluff over the warp sheet

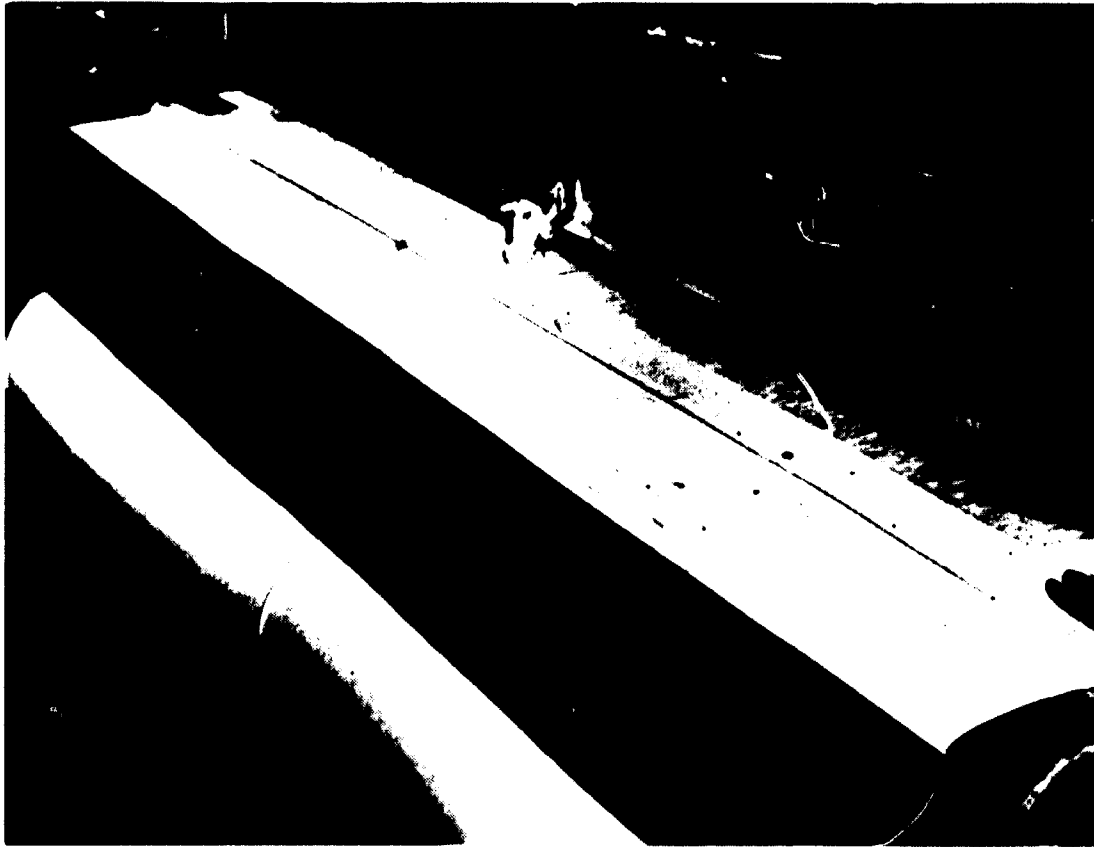


Figure 19. Dirty fluff over the cloth being woven

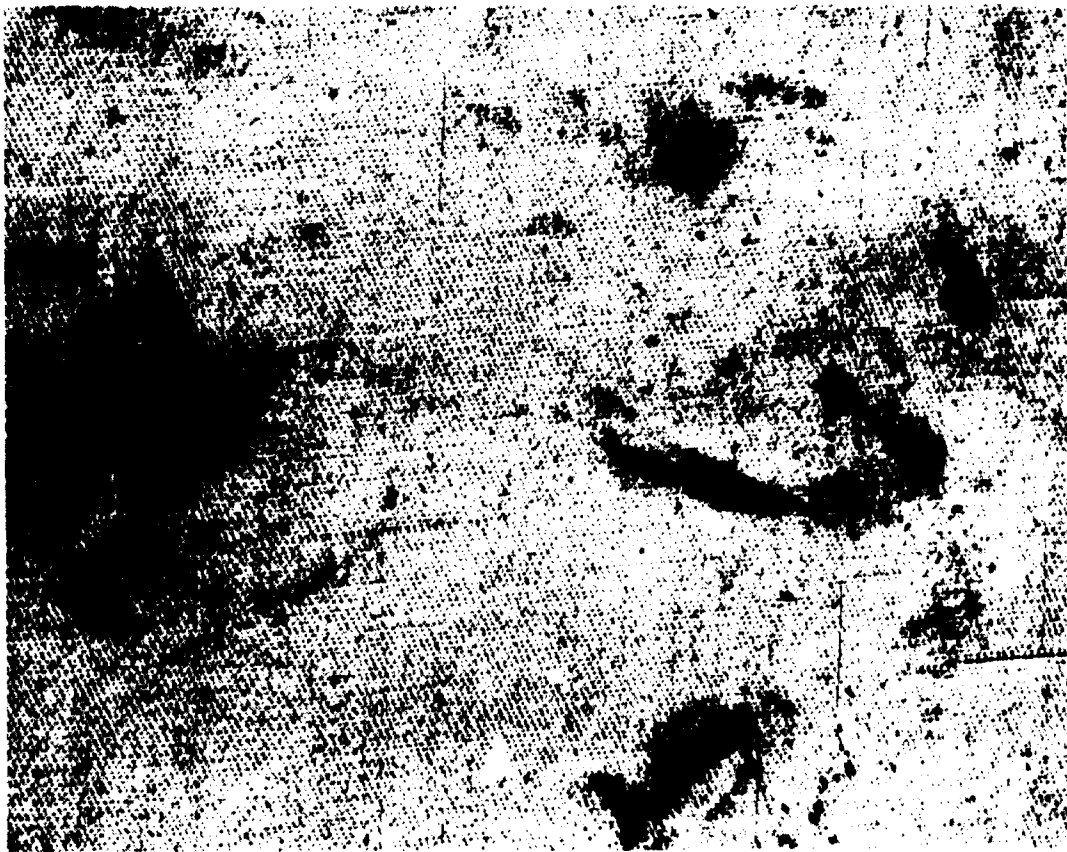


Figure 20. Stains from oily hands

Prevention. The shuttle boxes should be kept clean. Weavers should not be allowed to apply oil or grease to the shuttle eye and reed. The loom alley may be cleaned to remove dirt and oil, and the cloth or cloth roll should not be doffed onto the dirty floor. Weavers' hands should be kept clean by using a handwipe or cleaner.

Jobber or tackler

Causes. A jobber's hands tend to become oily and dirty and when he attends the underloom mechanism he holds onto the cloth roll for support with his oily hands. Similarly, when attending the overhead mechanism, dobbie, jacquard etc., he stands on the cloth. While attending to repairs, the dismantled machine parts and tools are kept on the cloth in front (figure 21). All these practices are responsible for staining.



Figure 21. Machine parts and tools kept on the cloth

Prevention. Jobbers or tacklers should keep their hands clean while touching cloth and warp sheets. They may be provided with a tool-kit and a canvas piece on which machine parts can be kept instead of on the cloth. A cloth curtain extending 4 in. from the fell of the cloth, up to 6 in. beyond the front rest, is another precautionary measure.

Materials handling

One of the important functions of materials handling is reduction of damage. This is in addition to cost reduction, increased efficiency, smooth and rapid flow of materials etc.

Of the many types of damage in storing and movement of materials, oil stains are the most serious. Lack of space, outdated machines and finance place limitations on efficiency, but there is still ample scope for improvement.

Ring frame bobbins

Some mills use cane baskets, jute bags and box-type trollies for the transport of ring bobbins. They are either dragged over the floor or taken by a platform trolley to the winding or weaving section. Where the manual doffing is done in small doff boxes, the bobbins can be directly placed on a three-tier trolley for transportation. The size of the trolley can be adjusted according to the size of the doff-bobbin box or basket and the alley space available. In mills where direct weft is used for weaving, handling operations are reduced. Alternatively, the doffed ring bobbins can be transferred to a box trolley which is taken directly to the weighing scale platform and then to the winding or weft room. Chute arrangement can be utilized to transfer bobbins from one floor to another.

Weft rewound pirns

Pirns can be filled in small light-weight boxes with count marking and conveniently transported directly to the loomshed.

Cones and cheeses

The box-type trolley (spring loaded), pin trucks or trident stands are suitable for the handling of cones and cheeses. The use of jute bags and baskets loaded with cones or cheeses and dragged manually should be stopped to avoid staining. Keeping cones or cheeses in an open heap is a bad practice (figure 22).



Figure 22. Yarn cheeses stored in the open in a dirty corner

Warp beams

Warp beams are stored uncovered one over the other allowing the rusty or oily flanges and ruffles to rub against the yarn surface of the beam leaving dark deep stains. The rubbing or hitting of the yarn body against the loom machine parts while transporting and loading over the beam bracket on the loom also causes warp group stains (figure 23).

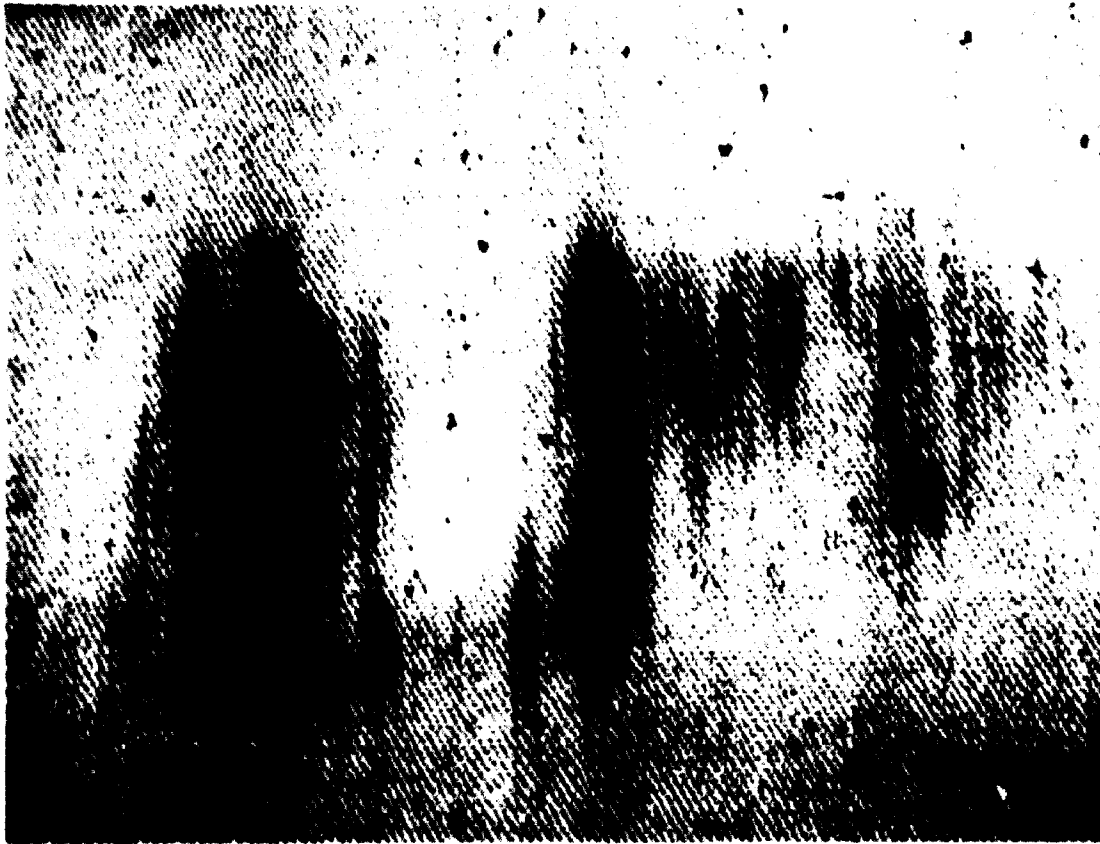


Figure 23. Stained warp group

In many mills, it is not possible to install overhead monorail due to the layout and lack of space and such mills have to depend upon conventional beam trucks. In the ordinary overpick loomshed of mills set up many decades ago,

the gangway is so narrow that any mechanized means of transportation would be difficult. The use of conventional beam trucks involves more manual operations. Their drawbacks can be eliminated by the use of a hydraulic beam truck. The loading and unloading of the beam can be carried out mechanically in an auto-loomshed.

The storing or stacking of the beams has to be done carefully; they must be well covered and not hit or touch other beams. If possible, the beams should be stored in a beam creel or in a vertical round beam creel.

Cloth and cloth rolls

Usually, the doffed cloth or cloth rolls are kept in a gangway on the floor. Box trays and cloth-roll stands should be provided in loomshed gangways for the temporary keeping of cloth or cloth rolls, or the doffed cloth or roll should be directly transferred by box trolley or cloth-roll trolley to the grey warehouse, which will minimize handling stains. The edges of the cloth roll usually get stained during transportation by hitting against the dirty floor or machine parts (figure 24) and should be covered with a hessian or canvas cloth piece to prevent this. Alternatively, the design of the trolley should be such as not to expose the cloth roll ends to staining or damage. In a grey warehouse, the cloth should be preferably stored or stacked on a wooden platform.

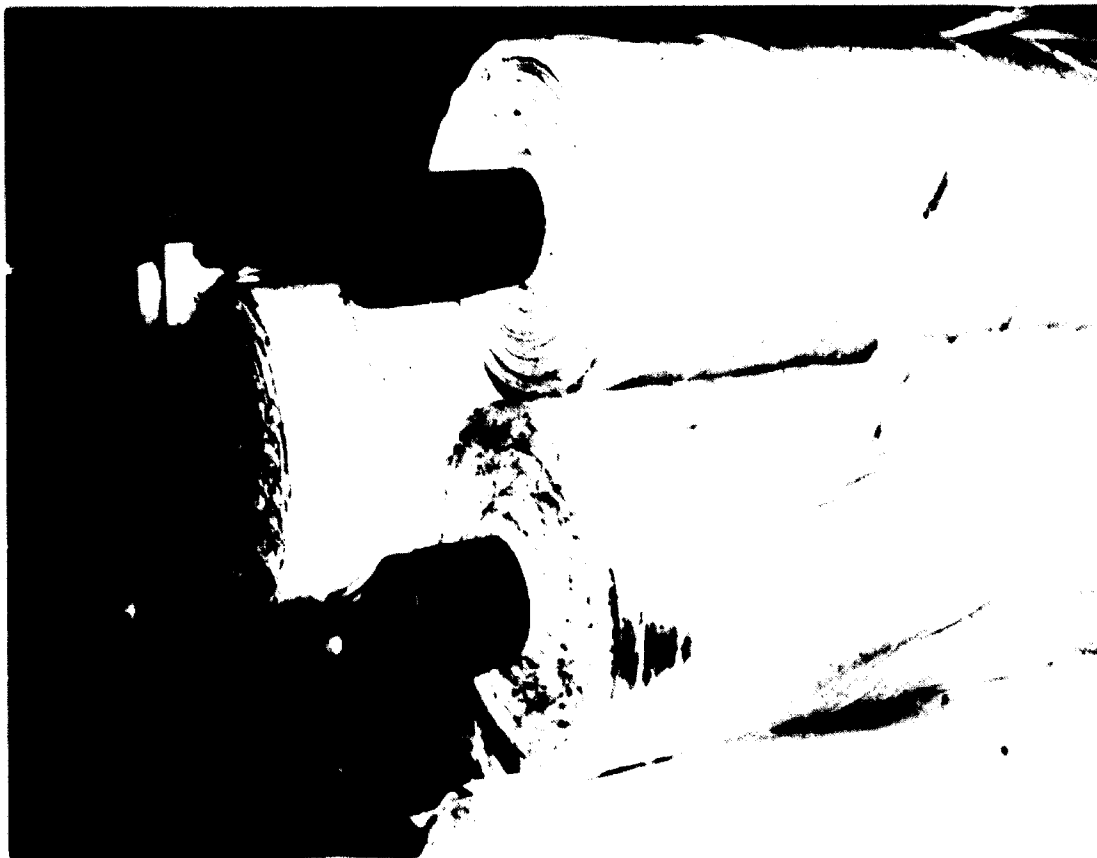


Figure 24. Cloth roll edges stained during transportation

Wet processing of cloth

Oil stains from wet processing are few and far between because the wet fabric is not easily stained by oil which is hydrophobic and oiled or lubricated machine parts are not near the passage of the cloth. Black carbonaceous spots in the form of pin-heads come up suddenly and also stop suddenly, leaving no hint of their source. Likely sources of such staining are drying, stentering and heat-setting machines.

Stamping or marking of grey cloth

Causes. The use of tar or unsuitable stamping ink, stamping the plaited or folded piece without a pad underneath, stacking the stamped pieces one over the other before the stamping ink dries cause stray staining of unstamped portions. In open width bleaching, the adjacent layers of the hot rolls pick up the tar marking and thus multiply the staining.

Prevention. The use of a cloth or absorbent pad beneath the cloth layer while stamping, selection of a quick-drying stamping ink and avoidance of a marker such as tar which melts in the heat will minimize the stains from stamping or marking operations.

Shearing and cropping

Causes. Inadequate cleaning and over-lubrication of plain and plaiter bearings cause staining of cloth.

Prevention. Regular cleaning of the machine parts and wiping dirty or oily matter from the plaiter bearings will reduce such staining.

J-box

Causes. Oil dripping from the traverse bin piler stains piled fabric (figure 25).

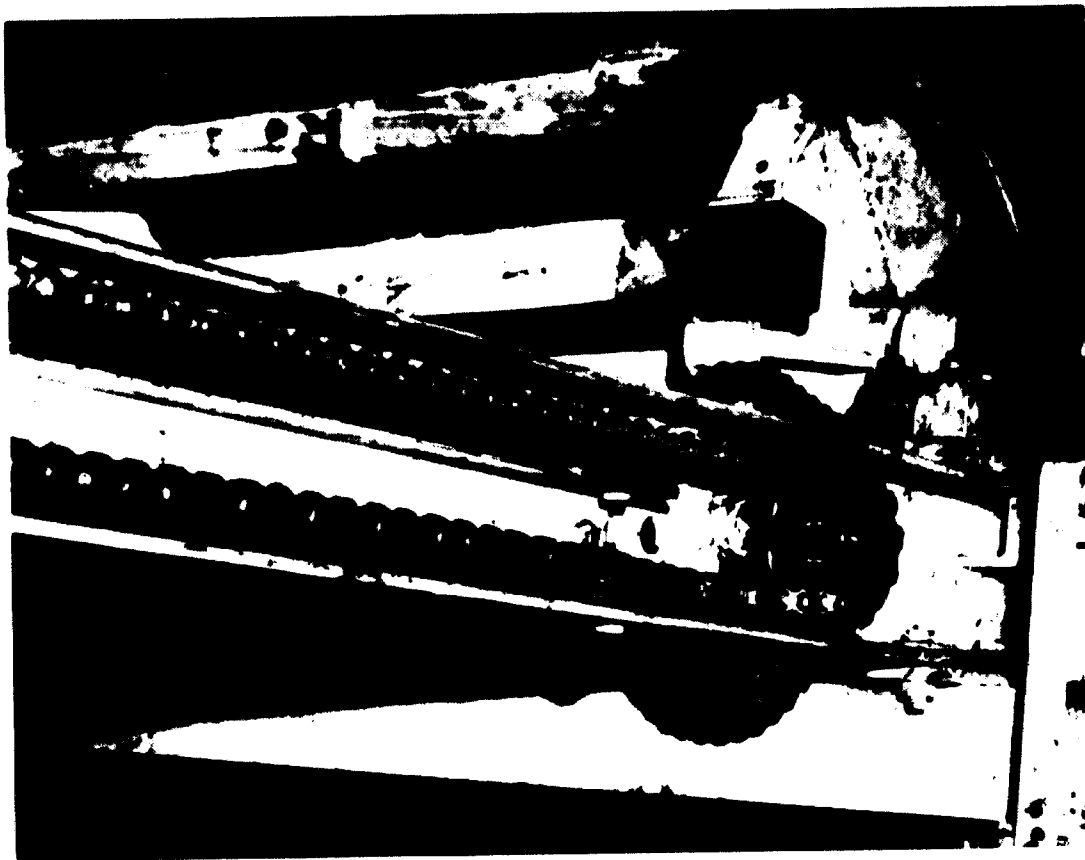


Figure 25. Accumulated dirt dropping from bin piler bearings and chain

The dripping of lubricating oils from J-box piler bearings and chains stains the fabric during its passage.

Prevention. The falling or dropping of lubricating oils from J-box piler bearings and driving chains can be prevented by providing a thick polythene cover or tray underneath and cleaning them frequently. Over-lubrication should be avoided and a suitable non-drip or sticking grease used. Iron rail wheels should be replaced by nylon wheels, which do not need lubrication thus avoiding stain and rust damage.

Scutcher or cloth opener

Causes. When the cloth moves sideways in the scutcher scroll roll, the fabric acquires traces of black oil owing to the seeping of excess oil from the scroll roll shaft bearings. Oily scrolls produce impressions like tyre marks (figures 26 and 27).

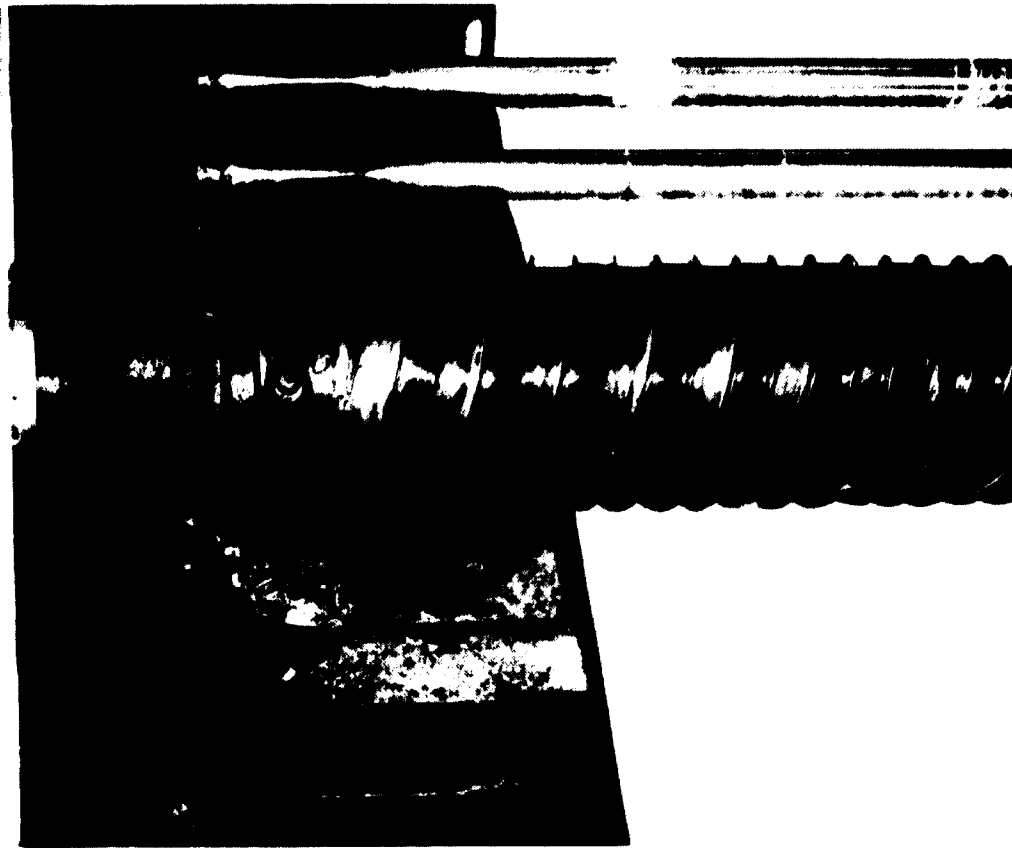


Figure 26. Oily scroll roll bearings



Figure 27. Fabric stained from scroll roll bearing

Prevention. Careful oiling operations and regular cleaning of scutcher scroll roll surfaces will minimize the black oil staining of cloth from the scutcher machine.

Plaiting device on all machines

Causes. Over-lubrication of plaiting device bushes or bearings causes the oil or dirt to drip over the cloth or trolley kept underneath (figure 28).



Figure 28. Oil dripping from plaiter bearing

Drying range with endless-chain clip machines

Oil oozing or spreading from the oil-lubricated head of endless-chain clips stains the fabric-holding clips and subsequently stains the selvedge of the passing fabric.

Mangle roll bearings

Grease drips from the mangle roll bearing into the bath and is picked up by cloth since the bath tray below extends beyond the bearings.

Prevention. Excess greasing should be avoided and the bearings kept clean.

Hot air stenter

Over-lubrication of blower motors and inadequate cleaning of exhaust chimney and air filters attached to the blower are the source of black spots on cloth. These machines should be cleaned in accordance with the schedules given in the manufacturer's manual.

When the baffle is not properly adjusted or the fan not properly functioning the condensate drips onto the cloth producing brown or black stains.

Calendering machine

Ends of the calender rollers if not cleaned regularly, may cause the staining of cloth selvedge when two pieces are run parallel (figure 29).

Hot water dripping from top calender rollers strikes the oily part of the lower rollers and spurts oily water onto the cloth.



Figure 29. Dirty ends of calender rollers

VII. GROUPING OF STAINS

Oil stains on cloth are classified in various ways, one of which is according to the state of the material when the staining occurs such as fibre, yarn and cloth stains (figure 30).

A more rational way is to classify them according to the processing sections such as stains from spinning, weaving preparatory, weaving, and the wet processing of yarn and fabric. This enables stain damage to be apportioned to the various processing sections in order to take preventive measures to minimize its occurrence. Depending on the nature, intensity, extent and location of stains, they are also classified as minor and major. Minor stains are to some extent tolerated while major stains have to be rectified.

There is another limited classification by the mending section or grey warehouse of a mill based on the easy cleaning of stains; one is mendable or repairable and the other non-mendable. Heavy blotches, streaks, dark broad oily wefts etc., which are laborious and difficult to clean fully, are considered non-mendable.

A survey revealed various types of stain that can be conveniently categorized as follows.

Oily warp

- (a) On single thread: this includes stains from spinning, weaving preparatory and weaving;
- (b) On group: these cover stains from warp beam handling, sizing and weaving.

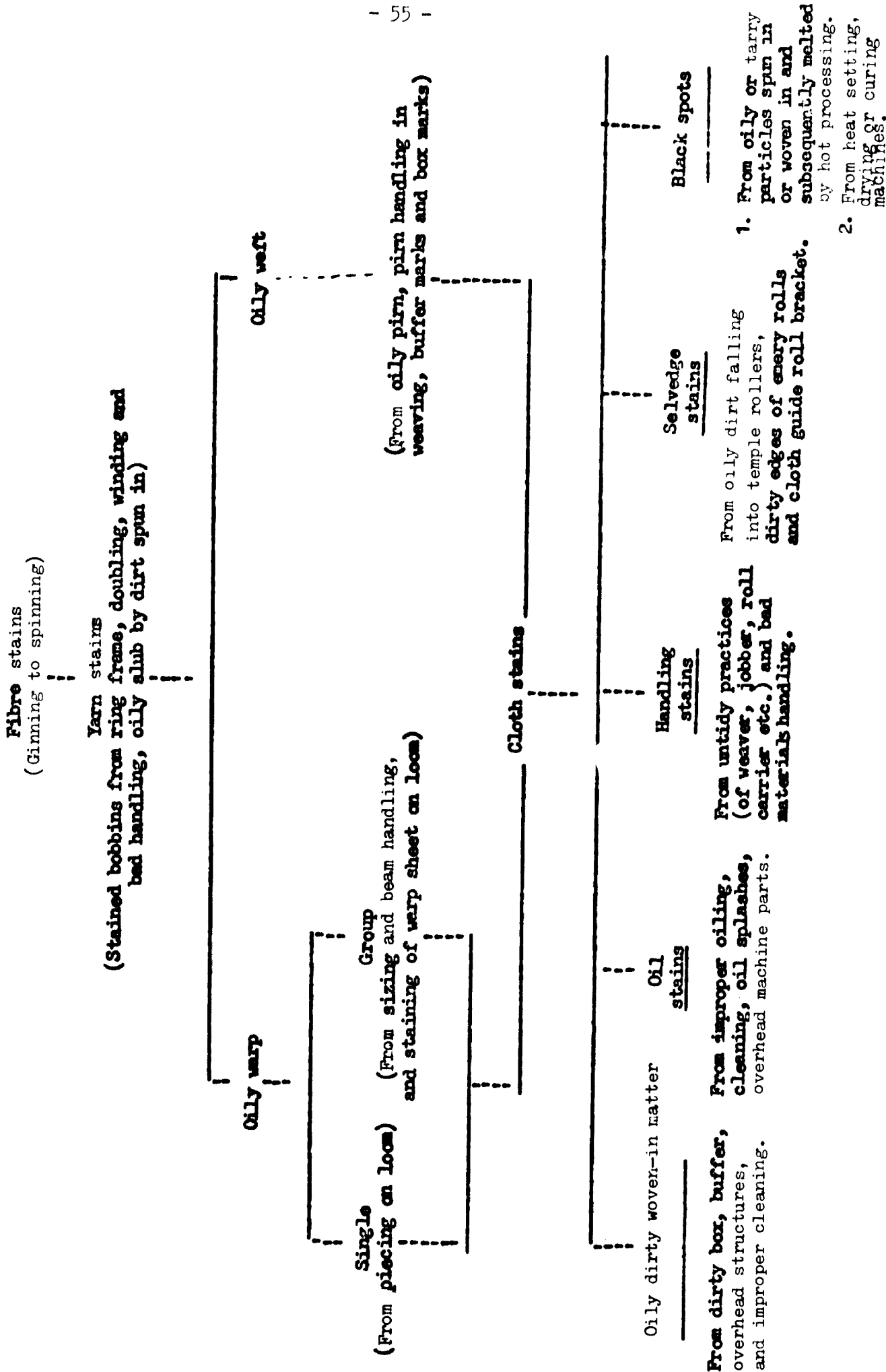
Oily weft

Oily weft stains include those from spinning, and pirn stains from weaving preparatory, pirn change, handling of pirns in weaving and box marks.

Fabric or cloth stains

Fabric or cloth stains can be subdivided into: oily and dirty foreign matter being woven in; oil stains on cloth; selvedge stains; handling stains; streaks; and stains and black spots from wet processing.

Figure 30. Grouping of stains



VIII. INCIDENCE OF OIL STAINS ON GREY FABRICS

A random survey was carried out in different Indian cotton mills on grey: medium count poplins, sheeting, shirting and longcloth. Stains were found to vary from mill to mill and from time to time.

Comparative staining of cloth from plain and automatic looms was as follows:

Cloth woven on plain overpick looms	12.3 per 100 m ²
Cloth woven on automatic looms	10.7 per 100 m ²

The contribution of different types of stains are given in table 4.

Table 4. Different types of stains
(Percentage)

Type of stain	Plain loom	Automatic loom
<u>Oily warp</u>		
Single thread staining	2.3	2.6
Oily dirty matter spun in	2.0	1.9
Piecing or mending stains	10.2	7.2
Oily warp group	22.4	20.0
<u>Oily or dirty weft</u>	15.3	13.1
<u>Fabric stains</u>		
Oily or dirty foreign matter woven in	10.5	7.2
Oil stains on cloth	17.0	26.3
Selvedge stains	0.3	4.7
Handling stains	<u>19.0</u>	<u>16.5</u>
Total	100	100

Oxidized or contaminated oil stains are not removed by normal scouring and bleaching operations, although a good number of handling and piecing stains are. Fresh oil stains are removed to some extent in wet processing.

IX. DETECTION OF THE SOURCE FROM THE STAIN

In spite of precautionary measures, a certain amount of staining is bound to occur because of the numerous men, machines and methods involved.

These stains can be detected, the source identified and corrective measures taken if a strict check is maintained on performance at every stage. In many mills, the stains are noticed only during the routine inspection or mending of the fabric in the final grey or finished state. When they are noticed, action has to be taken to trace the source in order to control further staining from that particular source. This is rather difficult as certain stains originate from more than one machine or department. Nevertheless the stains do provide certain clues that can assist a vigilant and experienced person to detect the source with reasonable accuracy. It is easier if the stains are examined when the fabric is in the grey state. The colour, shape, size, location, repetition etc., of the stain should be carefully examined for clues to its source.

Most lubricants give a characteristic glow under ultraviolet light. Comparing the fluorescence of the stain in grey fabric with the lubricants used can help in some cases to locate the machine or machine parts that are the source of the stain. This detection becomes difficult when the fabric is bleached, dyed, printed and finished, because these processes include the use of an optical brightener, and also when a fibre or filament, such as polyester, carries some fluorescent finish. Fluorescence of petroleum oils is ascribed to the presence of traces of aromatic compounds such as chrysene, fluorene or pyrene, or of substances in colloidal dispersion. Table 5 gives the fluorescence under ultraviolet light of some of the lubricants used in textile mills.

Examination of the stained portion under a microscope or magnifying glass can help to reveal whether the warp or weft is predominantly stained and whether the staining is on double or single yarn. Moreover, applying a grease or oil solvent during microscopic examination can reveal whether the stain is from grease, oil or some other substance. Examination of warp group stains with a magnifying glass will show whether the adjacent or intermittent warps are stained and whether the pattern of staining is circular or longitudinal.

Table 5. Examination of lubricants under ultraviolet light

Lubricant	Fluorescence under ultraviolet light
Teresso 140	Dull greenish-blue glow
Norva 275	No glow at the dark stained part but fringes show very dull green glow
Bevel grease	No glow at the stained portion
Spinnesso 34	No glow at the stained portion
Teresso 65	Dull green glow
Cylessso T.K. 140	Intense yellow glow
Nebula EP 2	Light-blue glow
Teresso 35	Bright bluish-green glow
Teresso 52	Bright-blue glow
Singer oil	Light-blue
Caltex light grease	Faint greenish fluorescence
Mineral oil No. 40	Bright bluish-white
Heavy grease	Yellowish-brown fluorescence
Vactra oil heavy	Blue glow
Multipurpose grease H	Bright glow
Becom No. 3	Light blue glow
Cyndol T.G. 140	Bright yellow glow
Surret fluid 50	Dark brown - no glow
Gear oil EP 90	Light blue glow with green tinge
Draft lube 2	Light blue glow with green tinge
Yantrol 43	Light blue glow with green tinge
Teresso 43	Pale yellow - no glow

Lubricant	Fluorescence under ultraviolet light
Enklo 140	Light blue glow with green tinge
Enklo 65	Blue glow
Spintek 35	Very light blue tinge - little glow
Turbinol 52	Very light blue tinge - little glow

Fibre stains

Fibre stains take the form of a lightly stained single thread of warp or weft. The yarn at the stained portions is not fully stained, with strands of stained and non-stained fibres spun together. This can easily be seen with a magnifying glass. The visual pattern will be not exactly alike but akin to a double yarn from single threads of black and white. This type of stain is quickly noticeable in bleached goods.

Stained slivers

Stained slivers occur as stained single warp or weft. Since the sliver gets attenuated considerably in spinning, the initial darker stain is stretched out to appear lighter and hazy. It can look like a shadow line and mostly becomes indistinguishable upon wet processing.

Bobbin stains

Bobbin stains are seen in fabric as stained yarn of warp or weft forming fairly long and intermittent lines.

Weft stains

Weft stains take several forms including:

(a) Oily weft bands; intermittent staining of weft; prominent short lines ($\frac{1}{2}$ -2 cm long) narrow or broad band to full width, all depending on the extent of the pirn staining. Pirns falling and rolling about on an oily floor result in longer lines and broader bands of oily weft running to the full width of fabric (figure 31);

(b) Short intermittent lines of more or less the same length ($\frac{1}{4}$ - $\frac{3}{4}$ cm) in narrow bands, with intensity fading towards the end of the band which generally result from a serrated oily weft feeler;

(c) Box marks; short length staining of a series of wefts on the starting side; weft staining more or less equi-distant from the box. The length and intensity of staining decreases on subsequent wefts. These stains can be traced to a dirty buffer, picker, or oily spindles;

(d) Intermittent weft staining caused by an oily shuttle running over its own weft;

(e) Continuous oily weft lines due to an oily pirn;



Figure 31. Oily weft from stained pirn

(f) Thick short lengths of dirt woven in or a weft-way streak of dirt from the shuttle box. If the streak has a warp-way tail, it may come from dirt dropped from overhead structures or blown from air-jet cleaning on the shed;

(g) Black spots on slubby weft which indicate foreign matter spun in.

Selvedge stains

(a) Any oily foreign matter sticking to the selvedge gets pressed by the temple roller and forms a streak (figure 32);

(b) Dark oily short lengths of single or groups of warp scattered at a few places near the selvedge indicate oil splashing on the warp sheet;

(c) Long yellow staining of selvedge yarns may be from the staining of the warp beam edge by the seeping of oil from the excess oiling of the chain let-off motion over the ruffle surface.

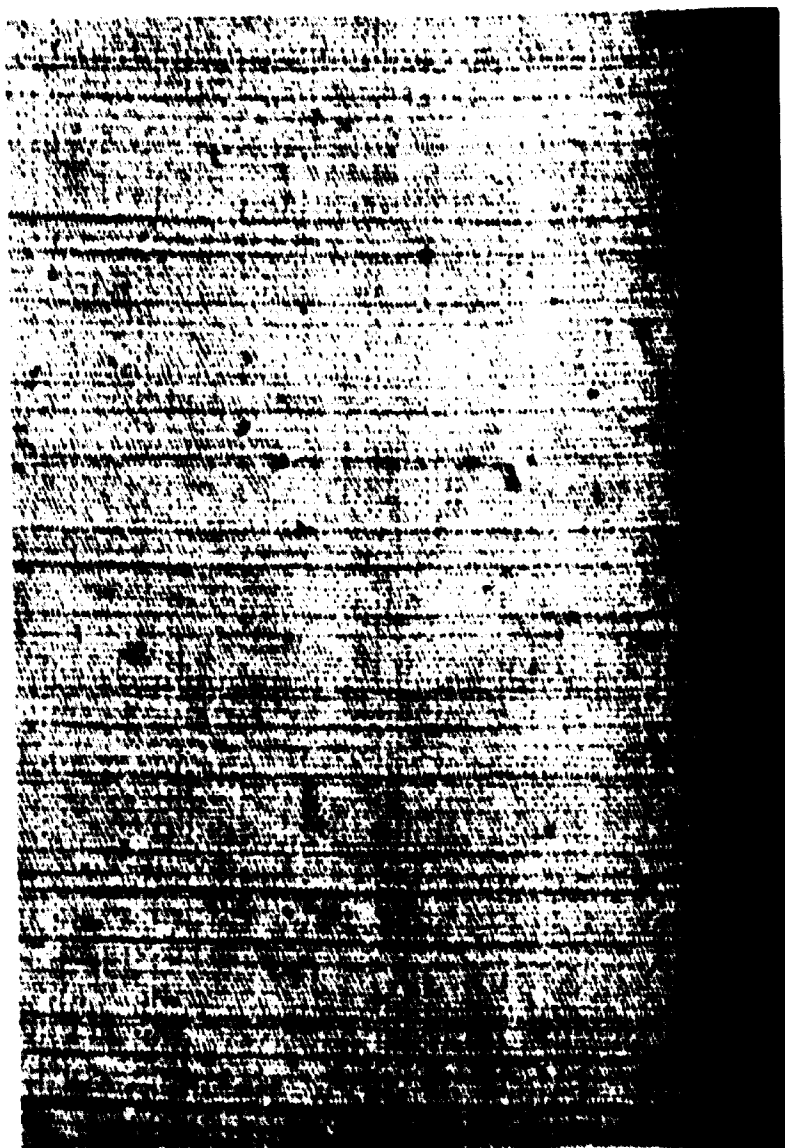


Figure 20. Selvedge staining

Oily warp

(a) Piecing or mending stain: single warp near knotting or piecing appears stained or dirty for a long length with or without staining of adjacent warp ends;

(b) Streaks with dark head and fading tail staining mostly alternate warp can be caused by the dropping of grease or oily dirt onto the warp sheet in between the heald and back rest. Such droppings can also occur from overhead structures;

(c) An oily warp group crescent shape can result from the core of another warp beam hitting and staining the yarn body during handling or storing of the warp beam;

(d) Alternate stained warp groups for short lengths with slight staining on interlacing weft can result from oil or oily fluff dropping onto the warp sheet between the healds and fell of the cloth;

(e) Adjacent stained warp groups indicate staining at warp beam.

Handling stains

Handling stains appear uneven and irregular on the cloth surface, and are more prominent on one side.

Yarn staining

Yarn staining from top weighting roller adjacent to the roller stand or open bushes in doubling frame causes long prominent lines of varying length.

Carbon soot

Carbon soot over doubles bobbins appears as light broken lines of varying lengths, mainly from 7 to 12 cm when woven as weft.

Yarn staining from multigroove ring

When yarn is woven as weft, staining from multigroove rings causes parallel lines at an interval of a few picks with the distance between the lines increasing and continuity broken towards the end of the band.

Repeat stains

When all stains are equidistant and detectable in grey, they may result from grease or oily fluff stuck to the emery roller. If the distance between stains varies, they may be due to oil or oily fluff blown over the cloth roll during loom cleaning or storing. Keeping the cloth roll over dirty oily fluff or grease particles can also cause this staining, but it then occurs nearer to the end of the piece.

The distance between stains gives a rough idea of the circumference of the emery roller or calendering roller involved. If the repeat stains are only on a group of warp, they may result from the splashing or dripping of oil on to the warp layers on the beam. The repeat stains may also occur

in drying operations at wet processing. Scattered black spots, pin-heads without any slub formation, fraying, distortion or knots, more prominent on one side and dissolved by oil solvents may originate at the drying, calendering, heat setting or stentering machines.

Part two

CORRECTIVE MEASURES

X. STAIN REMOVAL

Importance

In Part one measures to prevent the occurrence of stains have been given but preventive measures are not always foolproof, especially when numerous men, machines, materials and control systems are involved. Such stains that do occur will have to be removed and suitable methods adopted. Thus stain removal is important though not as much as preventive measures. As in the case of preventive measures, corrective measures are worthwhile only when the cost does not exceed the benefit.

When to remove stains

Stains in grey fabrics undergoing heat setting and wet chemical processing get "set" making them difficult to remove. It is therefore easier and more desirable to remove the stains at the grey stage. Some handling stains are only dirt without any oil or grease and are easily cleaned by normal scouring. Such stains are more laborious to spot clean because they are extensive and have no sharp borders. Hence some mills find fewer stains when spot cleaning is done after scouring. This may, however, necessitate additional operations such as drying the scoured fabric for spot cleaning and washing after cleaning. Here again, the drying process may to some extent fix the stains. Yet another practice is to spot clean the major stains in the grey stage leaving the light handling and minor stains for treatment at scouring and bleaching. Taking all factors into consideration, grey stage cleaning appears to be the most suitable.

Methods

The technique for treating stains can be grouped into three broad categories:

- A. Spot cleaning, which involves localized treatment of only the stained portion of the fabric.
- B. Padding or scouring, which covers treatment of the entire fabric. (In this group are included (a) padding; (b) special scouring; and (c) solvent scouring.)
- C. Masking of the stains by dyeing or printing.

A. Spot cleaning

Spot cleaning remains the most widely used method for stain removal. It is the only way of removing stains from fabrics sold in the grey state. Also, spotting is handy for stains occurring during later stages of wet processing or for stain removal after wet processing. Even if a stained fabric is intended for padding or special scouring, it is necessary to spot clean the dark and embedded stains. Spot cleaning is done in three ways: manually; with a spotting table; and with a spotting gun.

Manually

Most of the textile mills in India and other developing countries where labour is comparatively cheap, rely on manual spot cleaning together with examining and mending operations in the grey state. This is not the ideal way, but it has flexibility in meeting the volume of work with the least capital expenditure and without employing extra labour for spot cleaning.

Accessories

Illumination. The examination table should be adequately lighted for the detection of smaller, lighter stains and spots.

Table. Since spot cleaning is done along with inspection and mending operations, many mills use wooden tables. Spot cleaning on a bare wooden surface is likely to cause wood staining by the solvents used, therefore, it is preferable to have a glass, laminate or stainless-steel top.

Heavy stains, when rubbed with the stain remover, percolate through the fabric and spread over the table surface. This in turn stains the lower fabric surface creating a wider patch. To prevent this, an absorbent cloth pad should be inserted. The use of such a pad below the stained portion is a must when spot cleaning is done on a bare wooden surface. The pad will also prevent the varnish, remnants of stamping ink or tar on the table from getting dissolved or loosened by the stain remover and staining the lower surface of the fabric. A pad can be improvised by wrapping a scoured cloth over an aluminium or plastic rectangular board. The pad should be frequently washed to avoid accumulation and transmission of dirt back to the fabric.

Containers for the stain remover during application. Containers such as a porcelain cup, enamel dish, glass bowl or high-density plastic drop bottle are used. Glass and porcelain are not affected by stain removers, but are fragile and therefore require special care. An enamelled vessel is comparatively safe in all respects. Low-density plastic containers collapse or leak as they are attacked by solvent stain removers. A high-density plastic drop bottle is more stable and it has the added advantages of better control over the transfer of stain remover and minimization of evaporation loss.

Transfer of stain remover. Stain remover is transferred with the help of a high-density plastic bottle. A stainless-steel icecream spoon, or cloth are also used. The use of a cloth tied over the tip of a bobbin or pirn is not rare.

For slight rubbing. For slight rubbing, a blunt-edged stainless-steel icecream spoon, wedge-shaped wooden or plastic piece, or white cloth tied round a pirn or bobbin tip are used. A bit of folded or rolled absorbent cloth is sometimes used for delicate fabric. The spoon and wooden or plastic wedge should be frequently checked for any uneven, serrated or sharp edges. There are some other gadgets used such as scissors, a metal comb, knife and tooth brush. These are prone to create iron stains, or cause fraying or damage to the fabric and are undesirable.

Wiping or mopping up. A plastic or enamelled vessel (small bucket or basin) with water and an absorbent cloth or sponge are suitable for wiping clean the loosened dirt, stain and excess stain remover from the rubbed portion. Wiping, though simple, is essential for manual spot cleaning to avoid halo formation.

Application of stain remover

The technique of application is as important as the type of stain remover in obtaining the best results. Incorrect application leads to patchiness or incomplete stain removal even if the stain remover is good. The application sequence is listed below:

- Keep the stained portion of the fabric over the absorbent pad.
- Apply the stain remover over the stain, wetting it and the surrounding portion thoroughly.
- Rub gently to quicken the penetration of the stain remover and loosen the stain; rub immediately after application to avoid evaporation of the stain remover and partial drying up; and rub while the stain is fully wet. If the stained portion gets partly dry, as in the case of a long stain, wet the dried portion again with water or stain remover for rubbing. Rubbing should be done towards the centre of the stain to reduce spreading. If the stain is hard, allow the stain remover to soften it before rubbing.
- Wipe out the loosened stain with a scoured or absorbent cloth, or sponge soaked in water. If any traces remain, wipe again with the wet cloth. If still not removed, wet with more stain remover and rub and wipe as before. Change the pad or wash when it becomes dirty.
- The cleaned wet portion can be dried with an air jet if available, but it is not essential.

Precautions

- The place should be well lighted for easy detection of smaller and lighter stains.
- A clean stainless-steel or glass surface with an absorbent pad should be used.
- Gentle rubbing should be adopted when fully wet with stain remover and confined to stain only.
- Worn out brushes and sharp or serrated edges of rubbing implement should be replaced or rectified to avoid chafing and fraying of fabric.
- Stain remover should be effective to avoid excessive rubbing. An emulsion type with a water-soluble detergent is preferable to a stain remover of a pure solvent type.

Use of spotting table

The spotting table has improved the technique of stain removal. The wiping and rubbing are done with the steam gun and the pad is dispensed with. Unlike manual spot cleaning, the cleaned portion is dried by air jet. The stain remover should be applied manually or with the help of a spotting gun. This is definitely an improvement on manual spot cleaning, but high capital expenditure and maintenance charges limit its use.

Spot cleaning tables are available in various designs. The right choice has to be made depending on the degree of sophistication required, turnover expected, fabric quality, availability and cost of equipment etc.

One type of spotting table has a stainless-steel inclined top, perforated in the middle with an arrangement for the collection of waste condensate water. A movable side-stand for stain remover and a foot-operated steam and air gun are also provided. The table is fitted with five rubber rollers, three on one side and two on the other, driven by an electric motor.

The stain remover is applied to the stained portion of the fabric kept over the perforated table top. Darker stains are gently rubbed. The steam gun is used to loosen the stain further and force the stain remover through the stain, thus washing out the entire stain in the process. The steam gun sprays with a continuous circular motion with the nozzle inclined to the fabric. The nozzle should be of the fish-tail type which is not prone to blowing holes in the fabric. After the removal of the stain, the air gun is used to dry the wet portion. The outer fringes should be dried first and the centre last.

Precautions

- The stained cloth should not be placed over a solid base for cleaning. A perforated backing or open base should be used.
- Fabric of very close texture should be placed as horizontally as possible for cleaning to avoid solvent running down through the weave.

Use of spotting gun

A spotting gun applies the stain remover, and rubs and flushes out the stain. It is ideal for use with a spotting table but can be used alone. Spotting guns are of many types: those with volume control and atomization adjustment can help effective cleaning. Adjustable nozzles are in vogue for the stepless effortless setting of spray cones. The gun shoots the cleaning fluid at high velocity right through the fabric weave, flushing and driving out the dirt.

Precautions

The spray pressure and concentration of the jet of the spotting gun should be adjusted to suit the fabric weave or structure. Delicate fabrics need a reduced pressure, otherwise, hole formation, displacement or puckering of the fabric will result.

- . The volume and atomization of the liquid should be controlled.
- . For health reasons, it is advisable to select the solvent in the stain remover with a toxicity rating of not less than 400 parts per million (ppm). The working premises should have good ventilation. A solvent vapour extractor system can be incorporated to control health hazards.
- . The correct clearance from the nozzle to the fabric surface should be determined and maintained, it should start approximately 20 cm from the fabric and the gun should be brought gradually closer till the fabric resists the pressure without fraying, generally from 5 to 20 cm.
- . Proper spot removal, by shooting the dirt out of the fabric, should be effected in a circular sweep working from the outside in towards the centre.
- . If a stain cannot be removed completely by spraying from the front, an additional spray should be tried on the reverse side.
- . To prevent halo formation on delicate fabrics, the transition from wet to dry surface should be kept smooth and gradual by applying a broader jet after the stain removal.
- . The worker should be well conversant with the adjustment and use of a spotting gun to get the best results.
- . If there is a heavy deposit or a crust it should first be loosened by scraping with a blunt edge. Hardened and well-set-in stains should first be wet with the fluid by a light spray, allowed to loosen and then the dirt shot out.
- . Rubbing the stain with steam- or air-gun tips, though common, should be avoided.

Limitations on the use of the spotting table and gun

- . Care and service of equipment and higher capital investment are involved.
- . Workers need to be trained in their proper use.
- . They are not suitable for broader width grey fabrics, which are mended and spot cleaned in plaited or folded form.

Causes of halo formation or secondary stains

The causes of secondary stains during spot cleaning are given below.

- . Ineffective stain remover.
- . Insufficient application of stain remover.
- . Rubbing the stain when not fully wet.
- . Absence of mopping up with a steam-gun or cloth soaked in water (not when spotting gun is used).
- . Absence of absorbent pad underneath the stain during manual spot cleaning.
- . Heavy rubbing or rubbing with sharp instruments injuring the fibre or fraying the fabric causing patchiness in subsequent processing.

Advantages

- It is possible to treat the stains individually and remove them effectively.
- When stains are few, spot cleaning is more economical than padding or special scouring (see below).
- It ensures perfect stain removal. Remnants, if any, can be seen and cleaned by further application or by mopping up with a wet cloth. This method of stain removal is applicable at any stage of manufacture.

Disadvantages

- Any localized treatment involving special cleaning or rubbing, unless carefully done, can injure or fray the fibres or yarns, which may lead to a differential whiteness or dye pick-up on subsequent bleaching or dyeing resulting in patchiness.
- It is laborious and costly to spot clean extensive stains occurring frequently such as oily weft. Being a manual method, it is subject to human error such as failure in detection and cleaning or incomplete cleaning.

B. Padding and scouring techniques

Padding

Cotton fabrics are seldom padded; rayon and polyester fabrics are occasionally padded. This method is useful when the stains are widespread and handling stains are frequent. The stained pieces are joined together and padded with a solution of stain remover; aqueous solutions of detergents or emulsions are generally preferred. The bath is diluted with water and maintained either hot or cold. The cloth is given two rounds with one or two dips each. The batched cloth in roll form is kept covered with a polythene sheet for from six to eight hours or overnight and then washed. The padding can be done before, together with or after desizing. The advantage of this method is that the entire fabric is given uniform treatment, which will avoid possible patchiness in the finished fabric.

Separate padding with the stain removers has its limitations. It may not be economical to have a preliminary padding of grey goods as a separate operation except when the staining is heavy and widespread. Moreover, the padding bath must be strong. The use of chlorinated or aromatic hydrocarbon

solvents is malodorous and a health hazard unless the padding is done with closed apparatus equipped with suction and discharge pipes in a well-ventilated place. Care should be taken that the solvents used in the stain remover do not dissolve or corrode the rubber or plastic rollers that may be fitted to the padding machine.

Special scouring

When normal scouring does not clean oil-stained fabric, special or rigorous scouring is necessary. Cotton fabrics rarely undergo this treatment because of the high cost. However, instead of scouring in a J-box, a rigorous scouring in a kier, under pressure, with special additives, can clean the stains on cotton fabrics more effectively.

Detergents, mostly of a non-ionic type, and occasionally emulsions of solvents are added to the scouring formula for special treatment of oil-stained fabric. The manufacturers of stain removers formulate recipes for open-width scouring of various cellulosic and synthetic fabrics to suit the composition and optimum conditions for their stain removers.

The following is a typical recipe for scouring oil-stained fabric:

Stain remover	5 g/l
Anionic detergent	2 g/l
Soda ash	2 g/l
Temperature	65° - 75° C for viscose rayon and polyester 75° - 100° for cotton
Time	1-2 hours

1. The starting temperature suggested is 50° C and the temperature should be gradually raised to the maximum recommended, and worked for another 30 minutes.
2. In the case of acetate rayon, the treatment is carried out at 50° C, and soda ash should be replaced with liquid ammonia.
3. In the case of nylon, soda ash is omitted or reduced to 0.25 g/l and the maximum temperature should not exceed 80°-90° C.

Solvent scouring

Chlorinated hydrocarbons and some other special solvents are efficient in removing fats, oils and waxes from cotton fabric. Their properties are used in the technique whereby the stained fabric is scoured in a solvent scouring plant and the waste solvent is recovered and reused. Oil-stain removal by this technique is not complete; some dark or heavily contaminated and carbonaceous stains are not cleaned.

Trichloroethylene, 1,1,1-trichloroethane, tetrachloroethylene (perchloroethylene), xylene, mineral turpentine (white spirit) etc. are generally suitable for solvent scouring. Tests carried out showed that trichloroethylene and tetrachloroethylene give the best results, but the latter is more stable and less volatile.

Advantages

Solvent scouring removes from the fabric not only most of the oil stains acquired during manufacture but also the natural oils and waxes. The process is rapid and suitable for continuous operation. Conventional alkali scouring is not needed.

Disadvantages

- High capital expenditure.
- High solvent recovery cost.
- Special safety arrangements needed to keep the concentration of solvent vapour around the plant within safe limits.
- Dark and adamant stains are not fully removed.
- Carbonaceous stains are difficult to remove.

C. Masking stains by dyeing and printing

Even after stain removal, most mills resort to dyeing and printing to mask obdurate stains. Grey pieces are segregated as "good" for bleaching and dyeing a light shade; more heavily stained pieces are dyed dark shades or printed in chequered designs after undergoing the normal scouring to reduce the intensity of the stains. Heavily spot-cleaned fabrics are treated similarly.

Technique of stain removal

Oil-stain removal is essentially a physical action, unlike the removal of iron stains, which is a chemical action. The oil or grease with its resinous oxidized part is not reduced or chemically changed but only dissolved, dispersed or emulsified, and removed. Solvent-base stain removers dissolve the binding oily or greasy part and the adhered dirt and other soiling matters are loosened and removed. Stain removers work by detergent or emulsifying action.

In scouring with alkalies and surfactants, oil is partly emulsified. Soap or detergent reduces surface tension and allows the oil to form a comparatively stable emulsion in water and it is thus separated from the fabric.

When stain remover contains solvents, detergents, emulsifiers, wetting agents etc., their combined action accelerates stain removal. When the stain remover is applied onto the stained portion of fabric, it spreads towards the periphery by capillary action till it dries up. While spreading, part of the dissolved or loosened stain particles are carried along with it. Insoluble impurities are carried in a colloidal form. Sizing materials may also migrate. Before the stain remover dries up, the stain should be adequately rubbed and wiped with a cloth soaked in water. If metal contaminants, such as iron, are in the oil, they may be partly left behind, leaving a light yellow tinge at the place of staining that can be removed by normal acid scouring treatments.

XI. STAIN REMOVERS

Solvents, detergents and their emulsions are commonly used either alone or in combination for oil-stain removal to suit the mode of operation.

Emulsions

In developing countries where manpower is comparatively cheap and sophisticated techniques are difficult to operate trouble-free, manual spot cleaning is the choice. For this purpose, emulsions are most suitable. Water-in-oil type emulsions are finding increasing favour for manual spot cleaning while the oil-in-water type is more suitable for padding and scouring. Water, solvents and detergents or emulsifiers are involved. The result is solvent action as well as detergent action. The emulsions are cheaper, too, compared to pure solvents and amenable to wiping or mopping up after manual spot cleaning. Components selected should be compatible to avoid separation of liquid phases. High-speed stirring with suitable detergents in sufficient quantities keeps the solvent in a stable emulsion.

Solvents

Solvents dissolve oil or grease stains and remove them by an action similar to dry cleaning. The range of solvents available is given in table 6 though some of these are of academic interest only. High cost, toxicity, volatility or lower efficiency restrict the use of certain of these solvents. Solvents are largely used in solvent scouring and spotting guns. For manual spot cleaning and padding purposes, solvents are usually employed as aqueous emulsions together with detergents.

For solvent scouring, white spirit and the chlorinated hydrocarbons such as trichloroethylene, tetrachloroethylene (perchloroethylene) and 1,1,1-trichloroethane are available. Tetrachloroethylene is preferred for its stability.

Spotting guns use stoddard solvent, toluene, xylenes, tetrachloroethylene, 1,1,1-trichloroethane generally alone but also in combination with detergents. The cleaning liquid should be thin, non-clogging and having moderate evaporation properties. Emulsions, unless very thin, are difficult to use in a gun.

Table 6. Solvents

Category	Material	Boiling point (°C)	Maximum allowable vapour concentration (ppm) ^a	Use
<u>Hydrocarbons</u> Aliphatic	Mineral turpentine	140° to 190°	500	Padding emulsion and solvent scouring
	Stoddard solvent	149° to 210°	500	Spotting gun
	Kerosene	150° to 275°	500	Spotting gun
	Benzene	80.4°	10	Spotting gun
	Toluene	110.0°	100	Spot cleaning and padding emulsion components
Aromatic	Xylenes	133° to 140°	100	Spot cleaning and padding emulsion components
	Carbon tetrachloride	76.3°	10	Spot cleaning and padding emulsion components
Chlorinated	Trichloroethylene	87.2°	100	Spotting and padding emulsion and solvent scouring
	Tetrachloroethylene	120°	100	Spotting and padding emulsion and solvent scouring
	Dichloroethylene	43° to 53°	200	Spotting and padding emulsion and solvent scouring
	Tetrachloroethane	142°	5	Spotting and padding emulsion and solvent scouring
	Chloroform	61.7°	25	Spotting emulsion
	1,1,1-trichloroethane	74.1°	350	Spotting and padding emulsion and solvent scouring

^a/ ppm = parts per million.

Category	Material	Boiling point (°C)	Maximum allowable vapour concentration (ppm)	Use
Hydrated	Cyclohexanol	161.1°	50	Spotting and padding emulsion and solvent scouring
	Methylcyclohexanol	114.9°	50	Spotting and padding emulsion and solvent scouring
Terpenes	Pine oil (steam-distilled)	Spot cleaning along with other detergents
Chlorofluoro	Trichlorotrifluoroethane	117°	...	Spot cleaning along with other detergents
Hydrogenated naphthalene	Tetralin (C ₁₀ H ₁₂) Decalin (C ₁₀ H ₁₈)	194° 193°	... 500	Spot cleaning Spot cleaning
<u>Other</u>				
Esters	Amyl acetate	148.4°	100	Spot cleaning
Ketones	Methylisobutyl ketone	117.9°	100	Spot cleaning

Emulsions of solvents with slower drying characteristics can be employed for manual spot cleaning. Solvents alone have a tendency to form haloes. Hence water-in-oil or oil-in-water type emulsions are found more effective.

Detergents

Detergents are used for padding, manual spot cleaning and special scouring.

Oil and carbonaceous soils are easily removed from cotton by deterative action but are very difficult to remove from polyester. Carbon-black diffuses into polyester but does not diffuse into cellulose. Polyester and polyester/cotton blend fabrics are more susceptible to oily soil and are more difficult to clean than cotton.

Detergents that are useful for stain removal may be divided into two groups, as below.

Anionic

Anionics are more effective for cleaning cotton than polyester and blended fabrics. Ammonium, sodium and potassium oleates are powerful detergents and emulsifiers and are non-toxic. Alkylaryl sulphonates, such as dodecylbenzene sulphonate, have all the gross effects - efficient wetting, emulsifying, detergent action on cotton and, to a lesser extent, on polyester and its blends - equally balanced. Aqueous soap solutions remove carbon stains completely while solvent barely touches them. These soaps are good for oil and carbonaceous stains and work best at pH 10-11. The drawback is that they are tenaciously held by the fibres and require thorough washing in hot and cold water, otherwise they are partly retained at the spot-cleaned portion causing discoloration during subsequent heat-setting operations or patchiness in dyeing due to differential absorption of dyestuff. To quicken the cleaning action, they are mixed with suitable solvents and made into water-in-oil or oil-in-water emulsions.

Non-ionic

Non-ionics have a more effective action on polyester fabrics than anionics and are easily washed off. Ethylene oxide fatty alcohol phenol condensates are the important ones. They have uniformly excellent wetting, emulsifying,

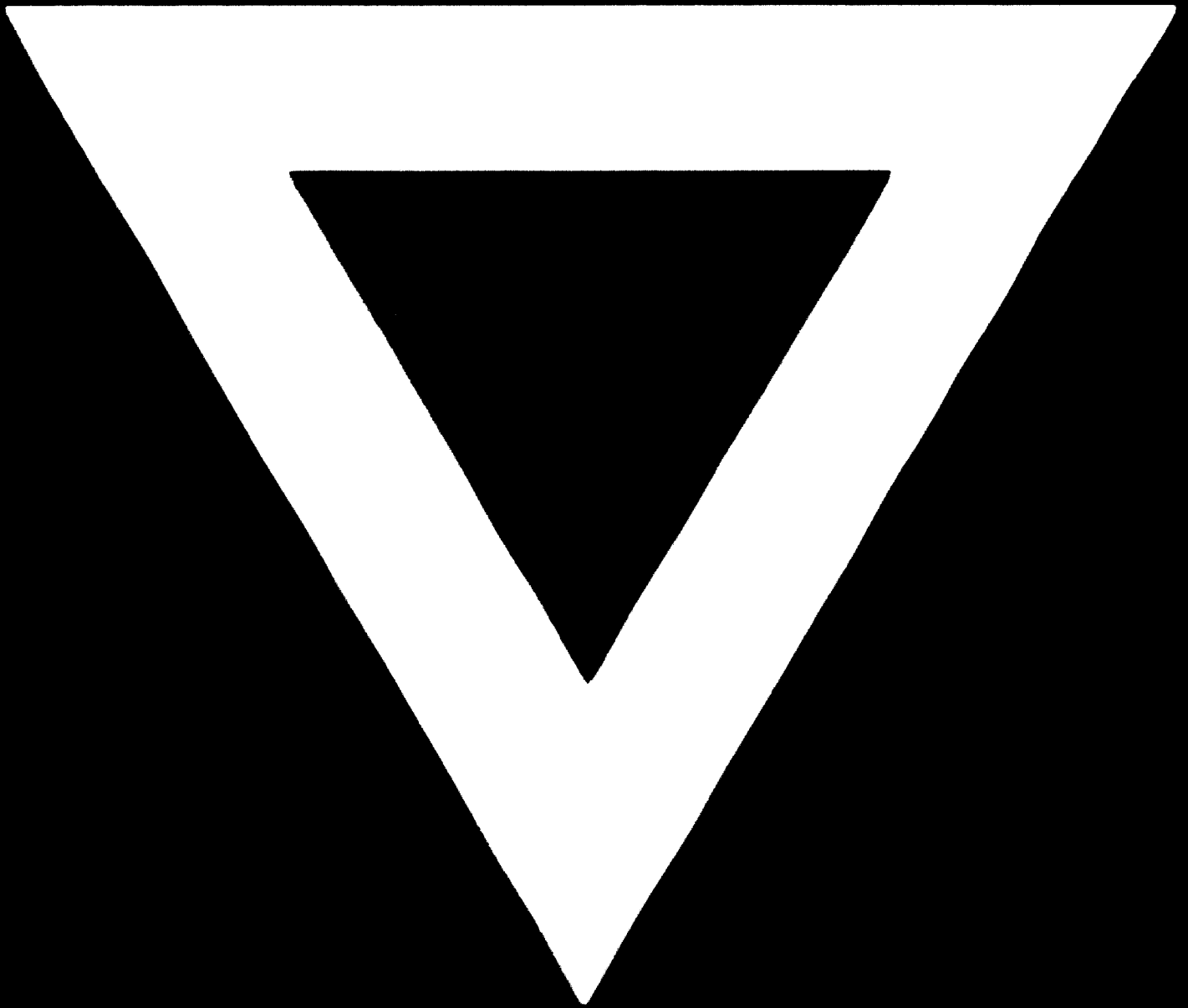
foaming and detergent properties. Ethylene oxide fatty acid condensates also are good detergents and emulsifiers with medium foaming and wetting power. Stains on resin-finished fabrics are very difficult to clean. They tend to diffuse over a wide area and get retained creating a phenomenon called the bullet-hole effect. Carbon spots acquired during wet processing are difficult to remove from polyester fabrics.

Evaluation

It is time consuming to test separately detergency, wetting and emulsifying power, foam power, solvent effect etc. For quick comparative tests, cloth strips stained with contaminated oil or grease should be given an equal number of strokes with a nylon brush in a wet scrubbing tester (which is used for evaluation of scrubbing fastness of pigment prints), wetted with an equal amount of stain remover, then washed and allowed to dry. The extent of the cleaning will give a rough indication of the efficiency of the stain remover.



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